

California Drought & Climate Outlook

September 15, 2016

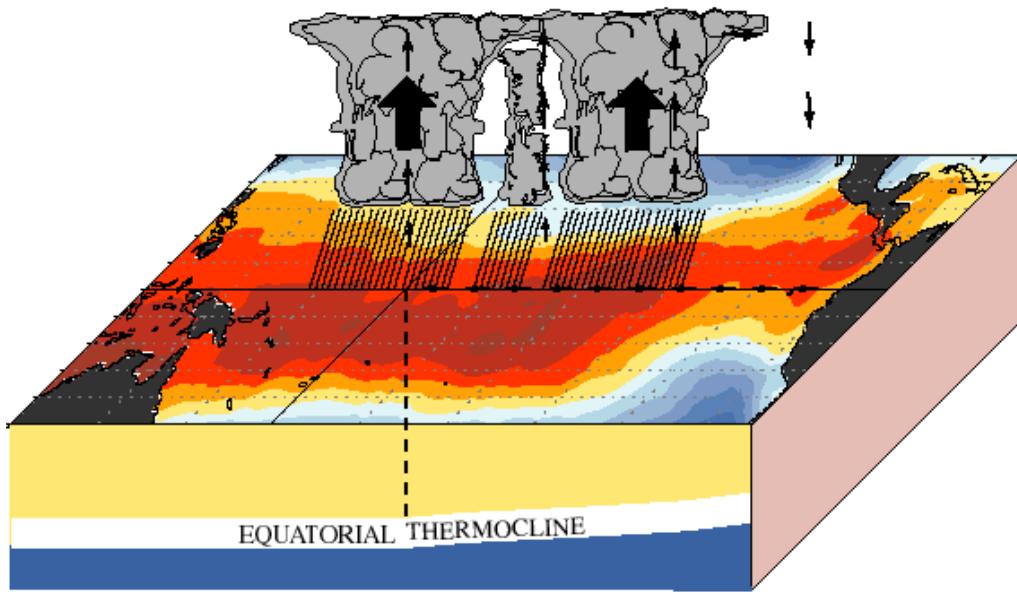
Amanda Sheffield

California-Nevada Climate Applications Program
Scripps Institution of Oceanography, UCSD

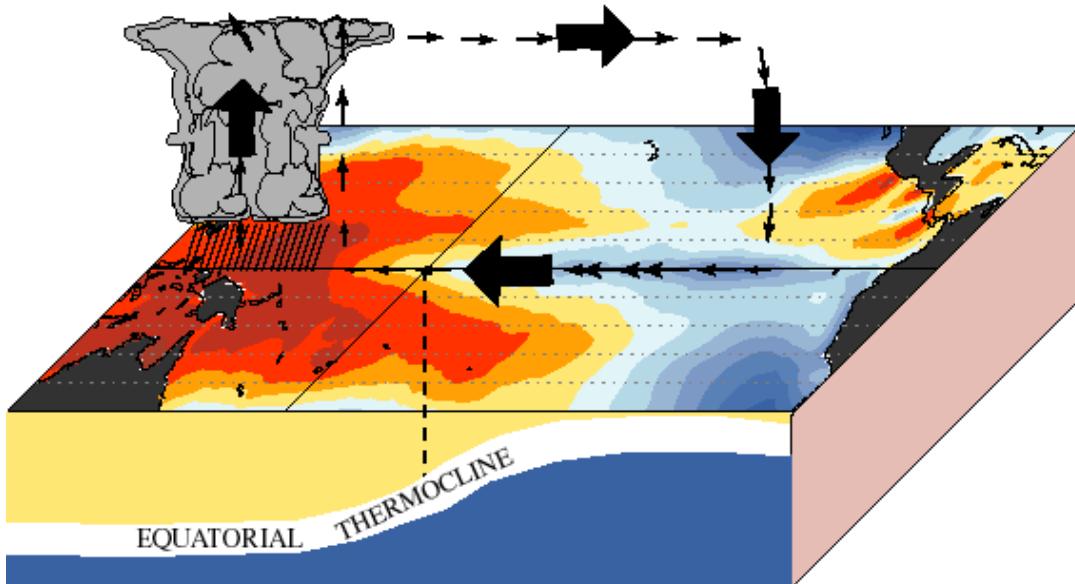
Alex Tardy

National Weather Service

December - February El Niño Conditions



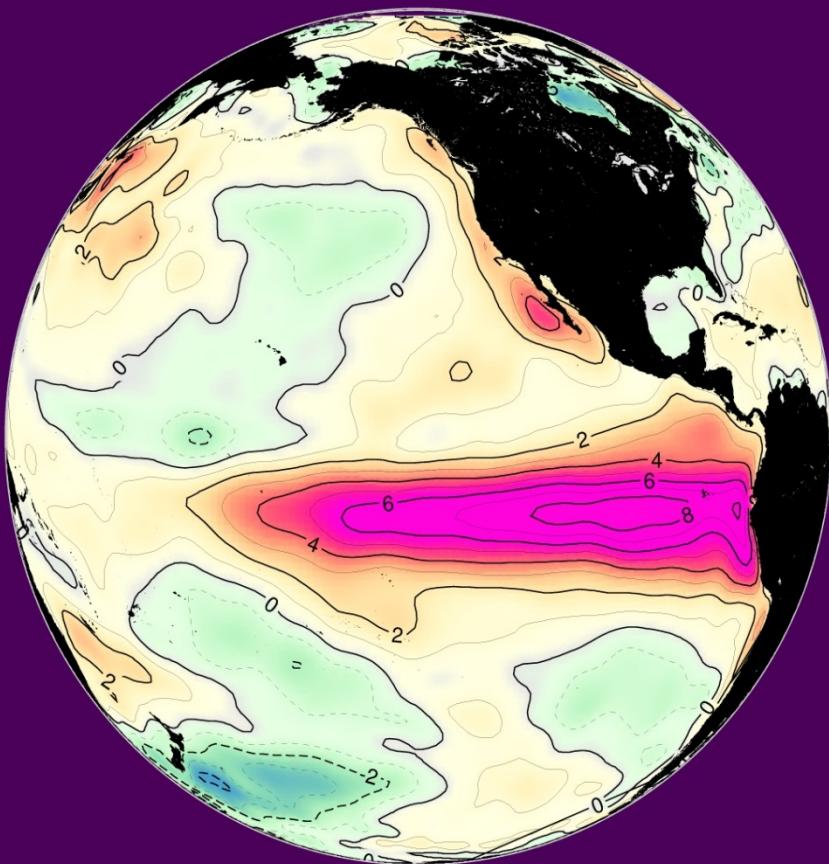
December - February La Niña Conditions



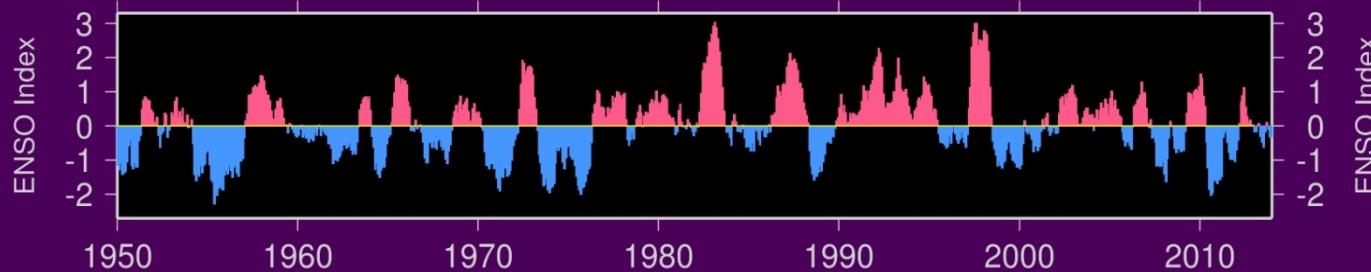
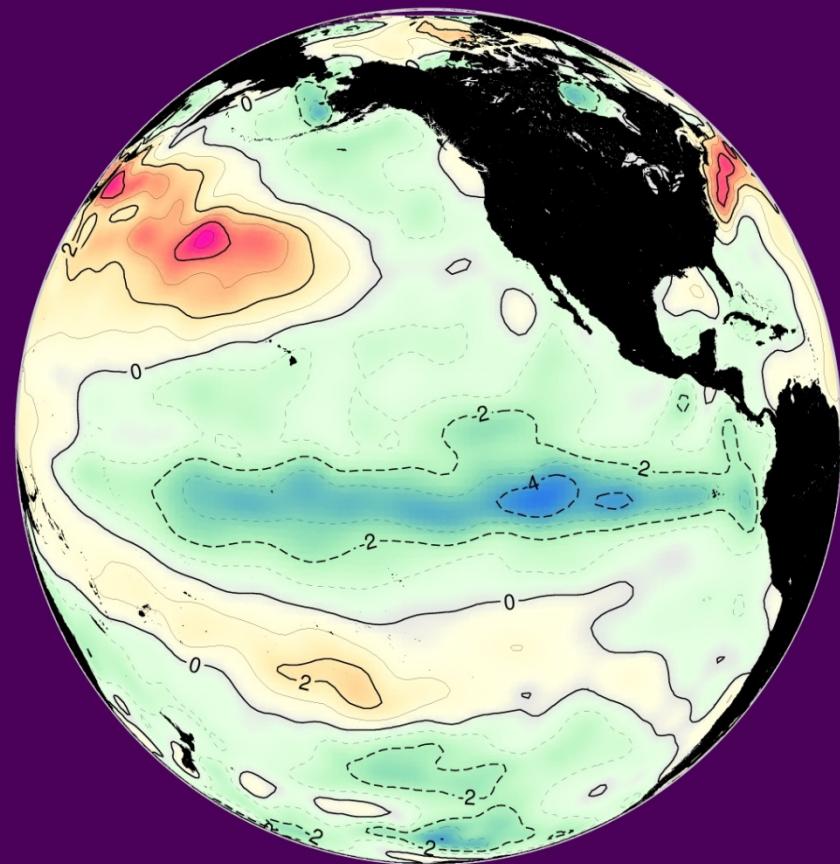
- ***ENSO Observations & Forecast with examples from previous La Niña & Neutral conditions***
- ***Sub-Seasonal to Seasonal Temperature and Precipitation Forecast***

El Nino/Southern Oscillation (ENSO) Sea Surface Temperatures (Departure from Normal)

El Nino (Dec 1997)



La Nina (Dec 1999)

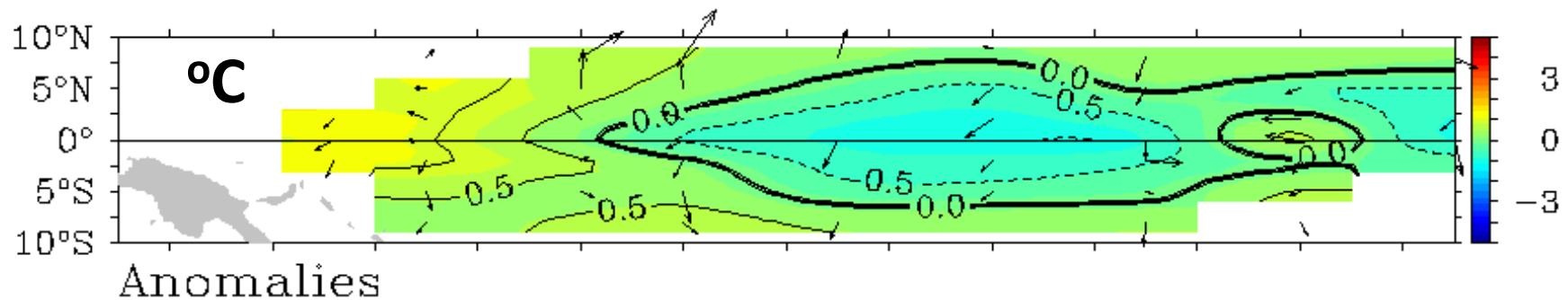


Current Ocean Temperature Conditions

(Departure from normal for this time of year, °C)



September 13, 2016

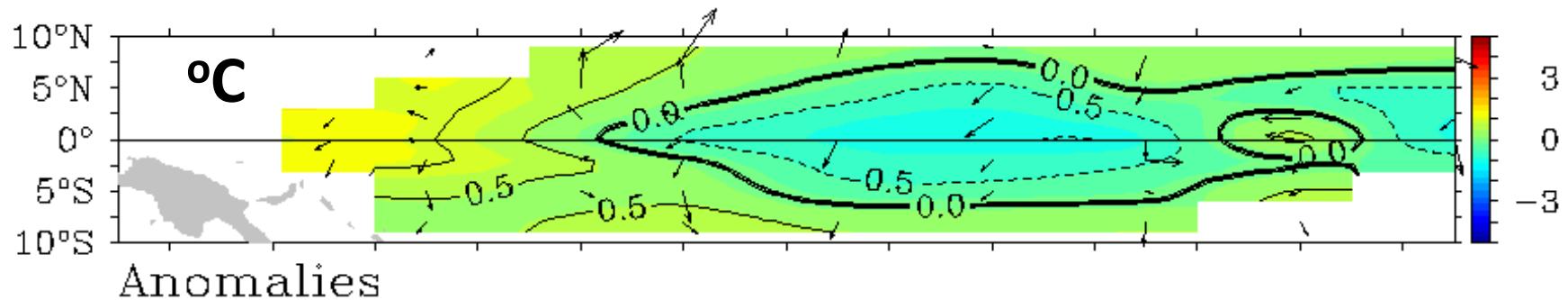


Current Ocean Temperature Conditions

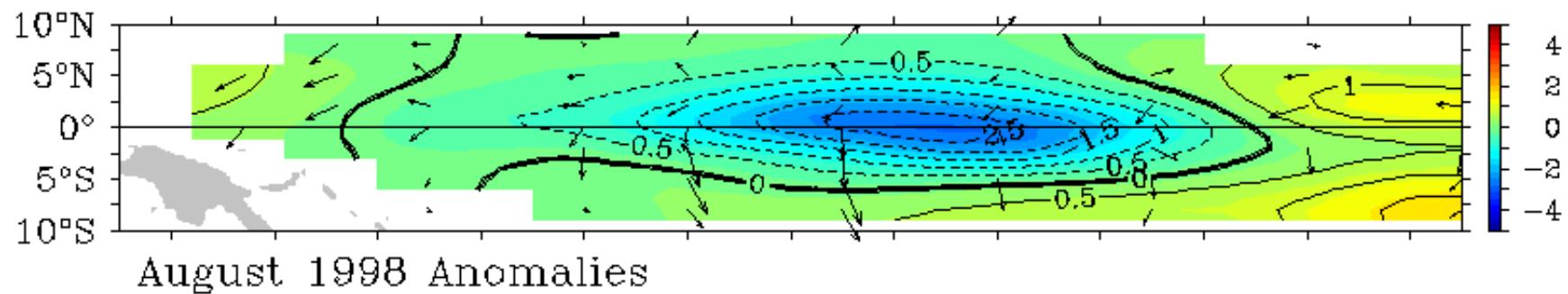
(Departure from normal for this time of year, °C)

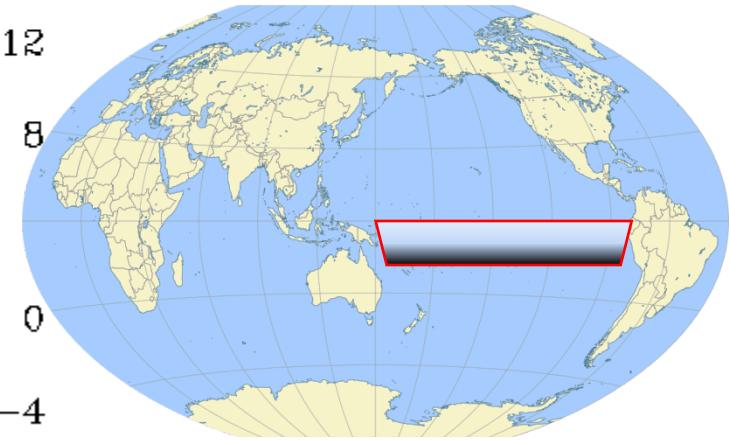
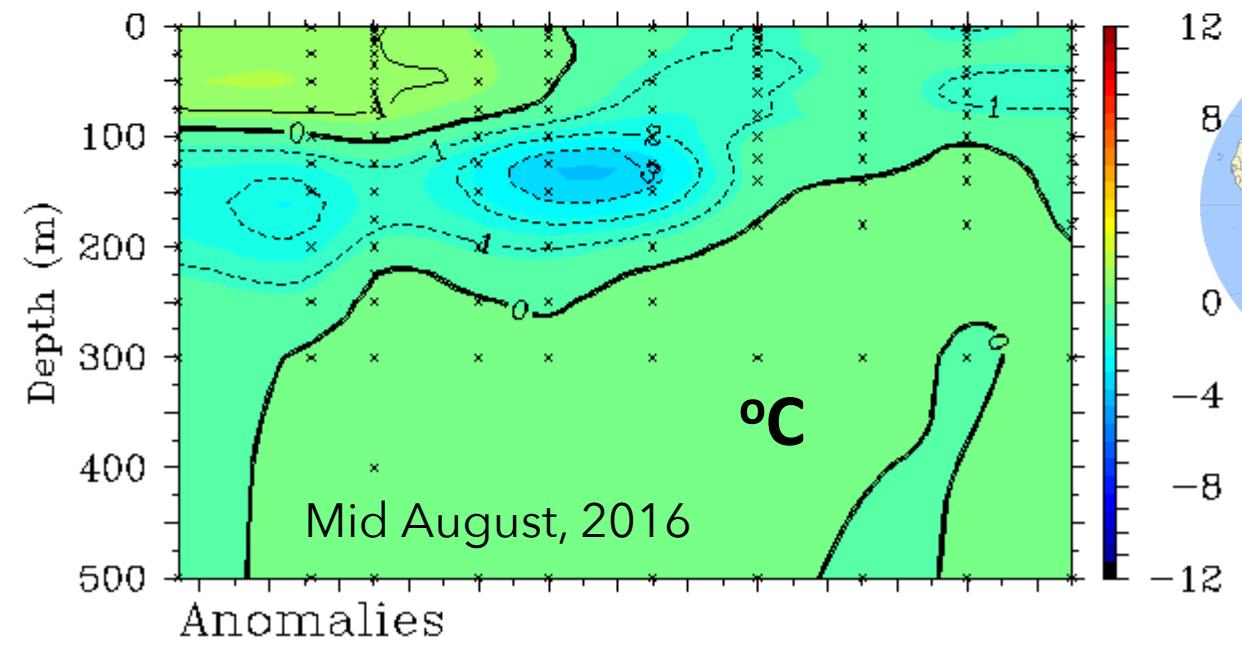


September 13, 2016

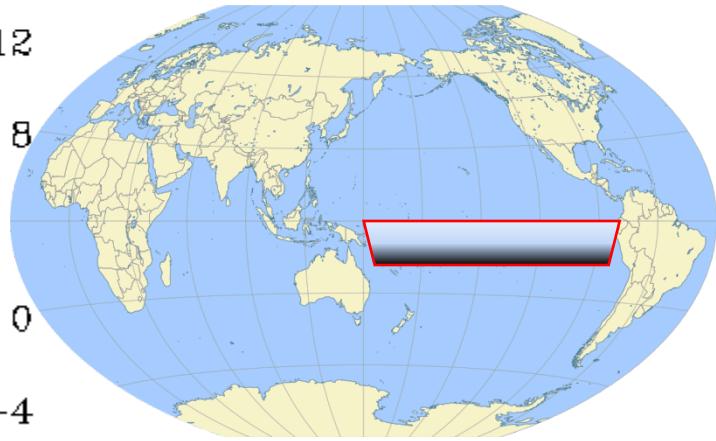
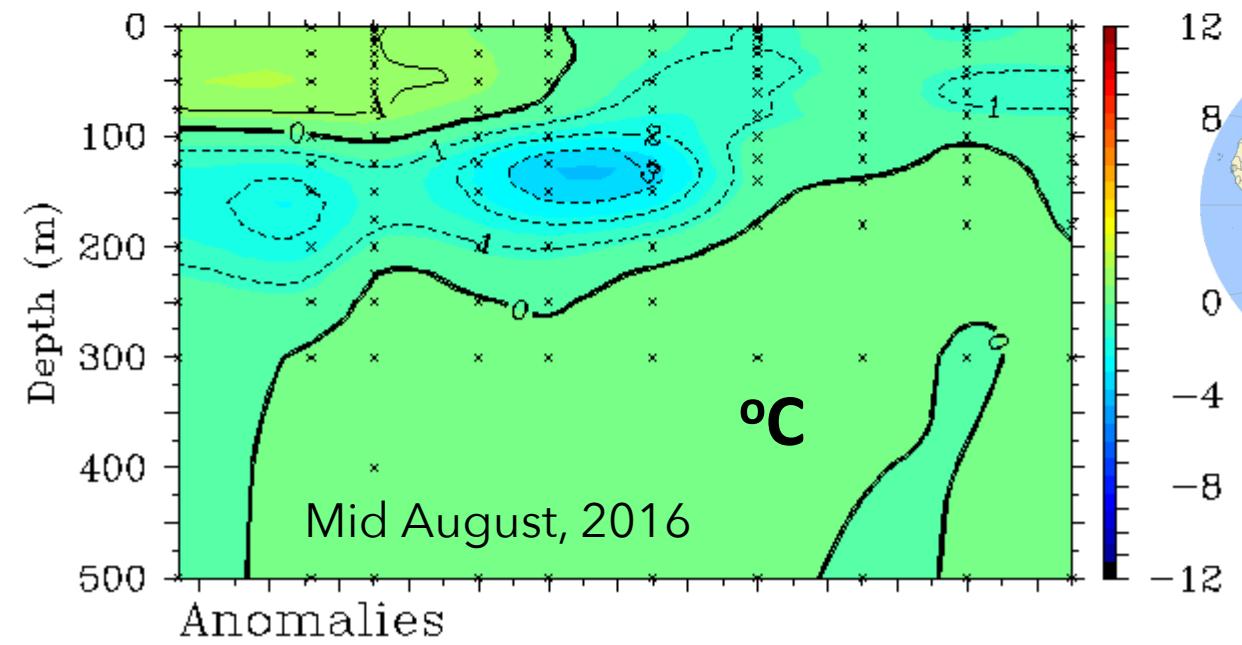


August, 1998





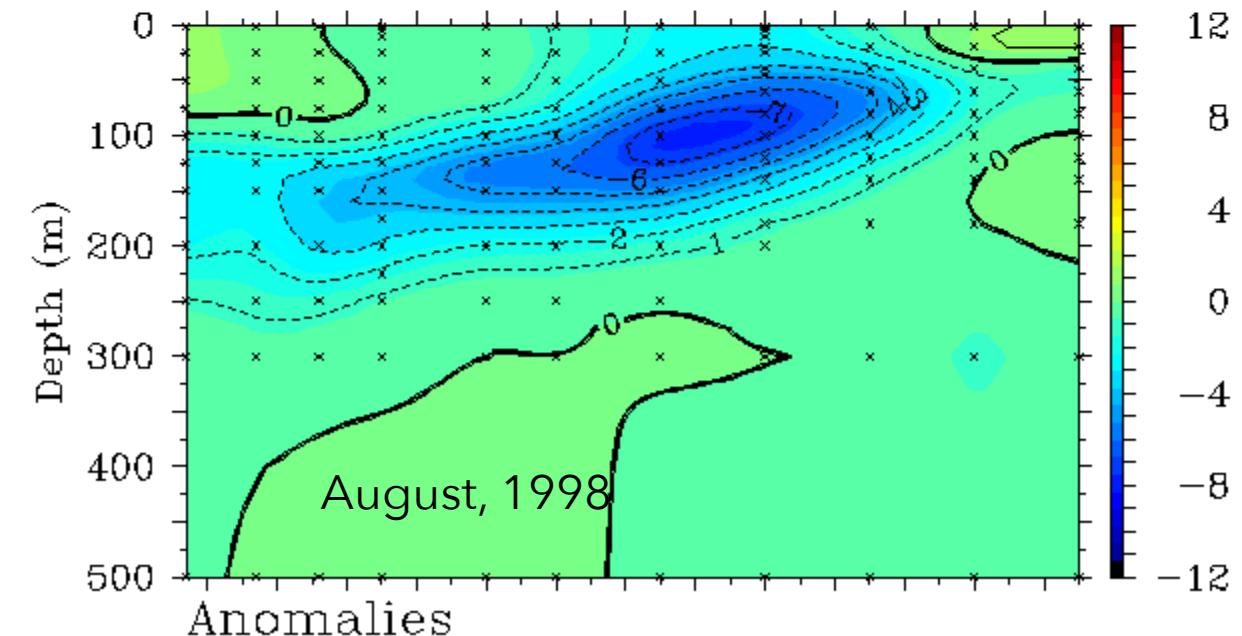
(Departure from
normal water
temperature for this
time of year, °C)



Anomalies

°C

Mid August, 2016

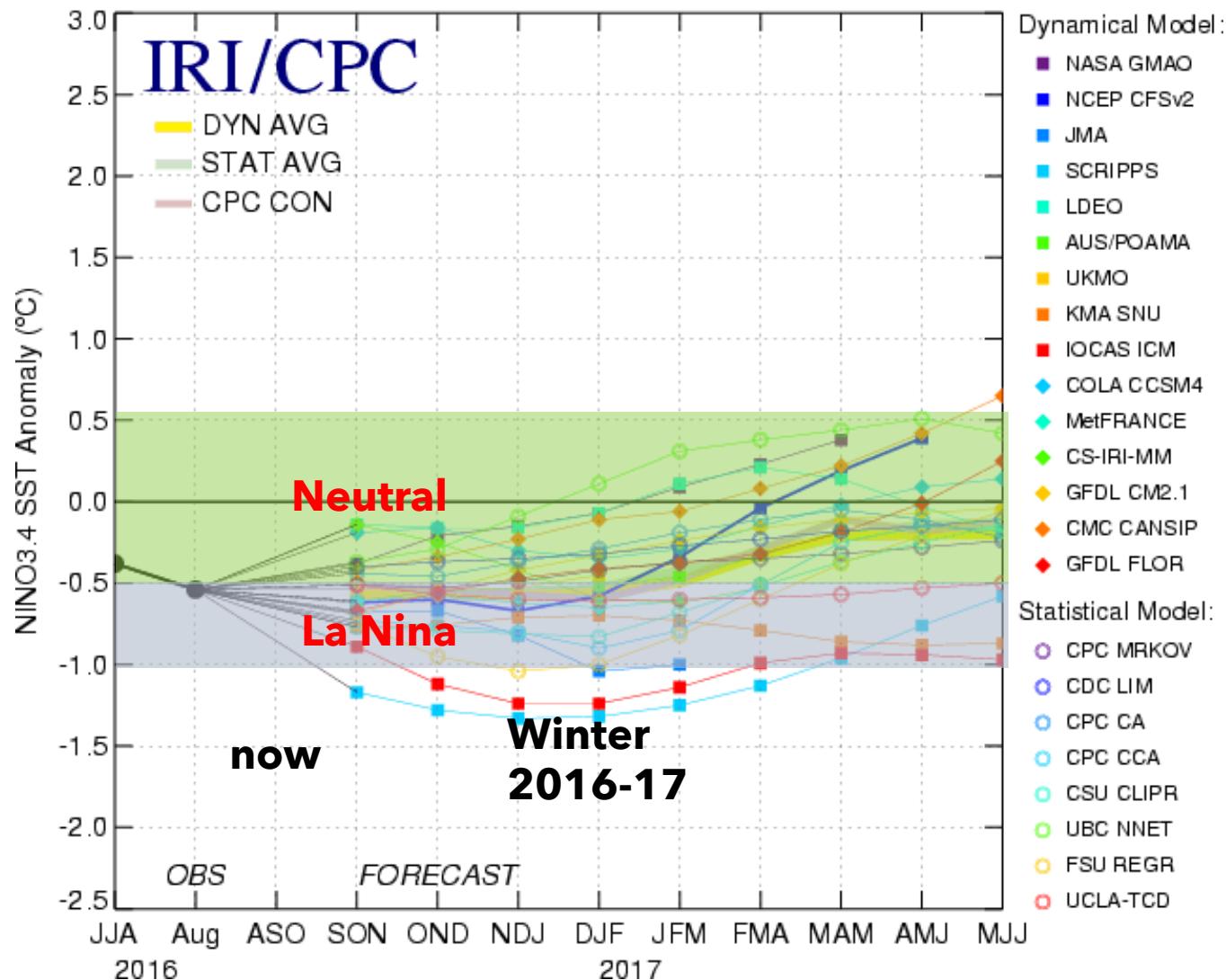


(Departure from
normal water
temperature for this
time of year, °C)

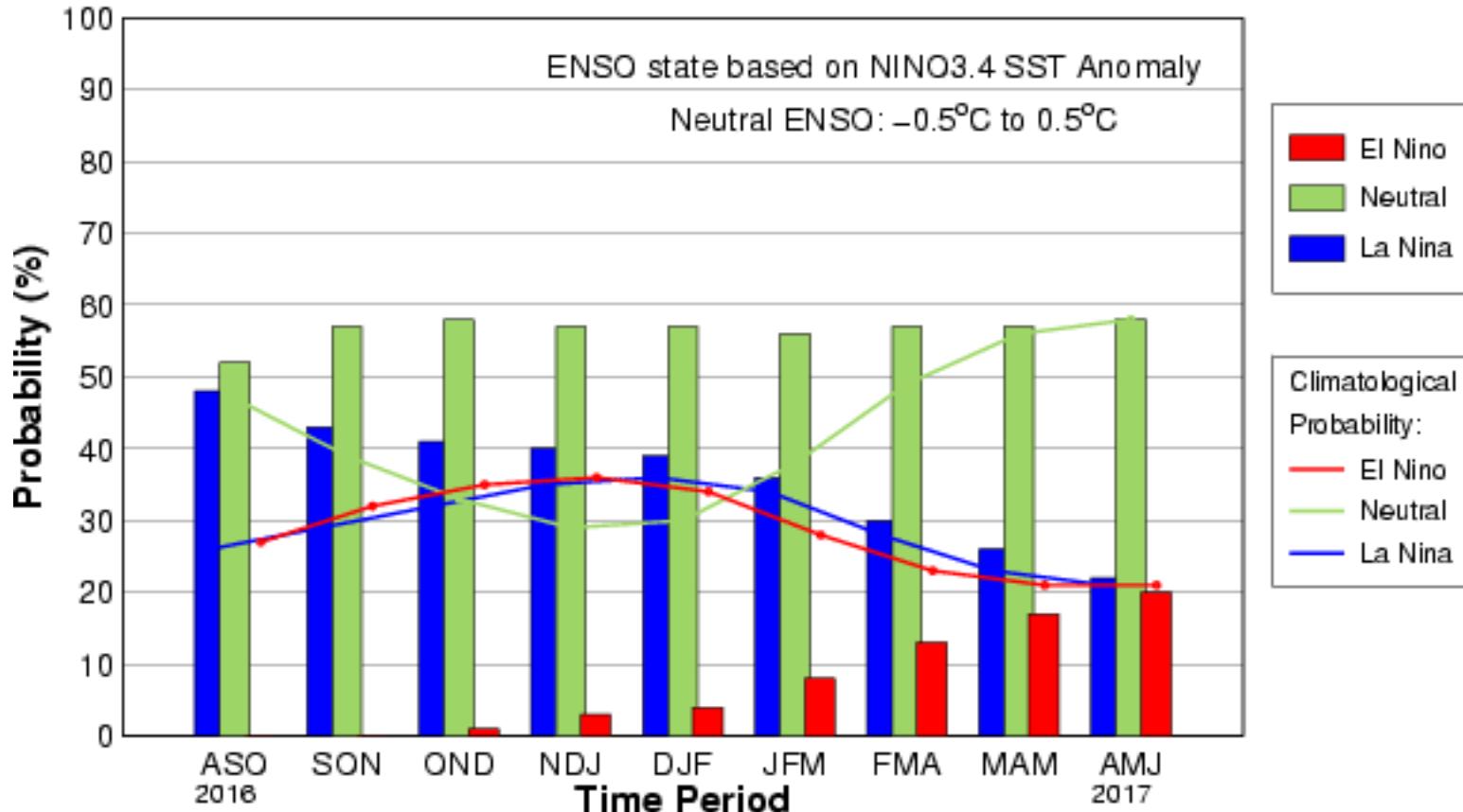
Anomalies

Current La Niña Forecast

Mid-Sep 2016 Plume of Model ENSO Predictions

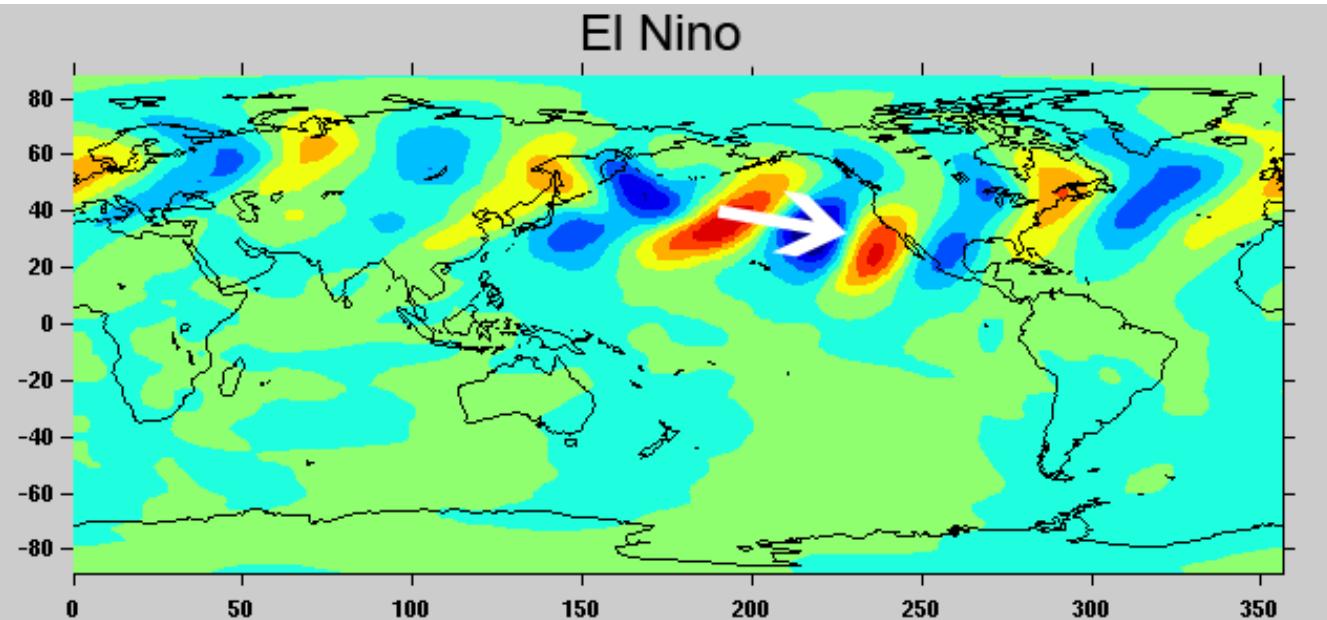


Early–Sep CPC/IRI Official Probabilistic ENSO Forecast

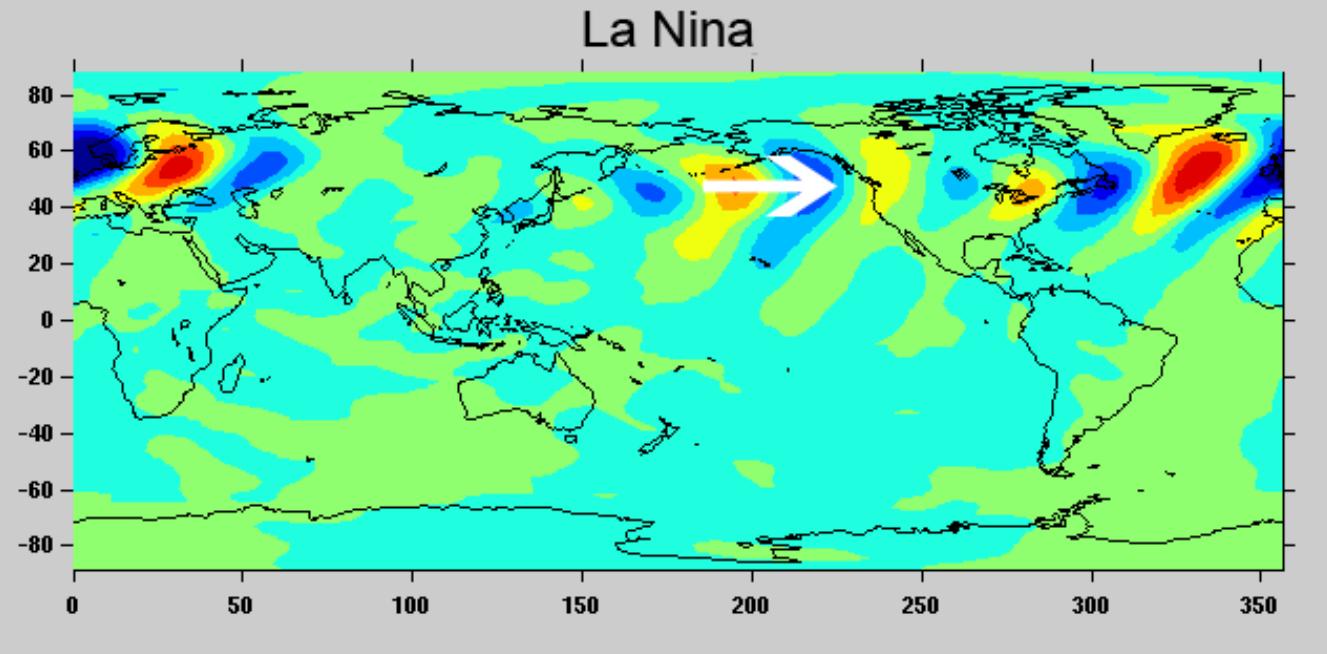


	La Niña	Neutral	El Niño
Climatology	35%	30%	35%
NDJ, 2016-17	39%	57%	4%

How does La Niña affect our weather?



Colored blobs show example storms coming across Pacific in El Niño and La Niña year



Average Effect of La Niña on Winter Precipitation

(Departure from normal winter, %)

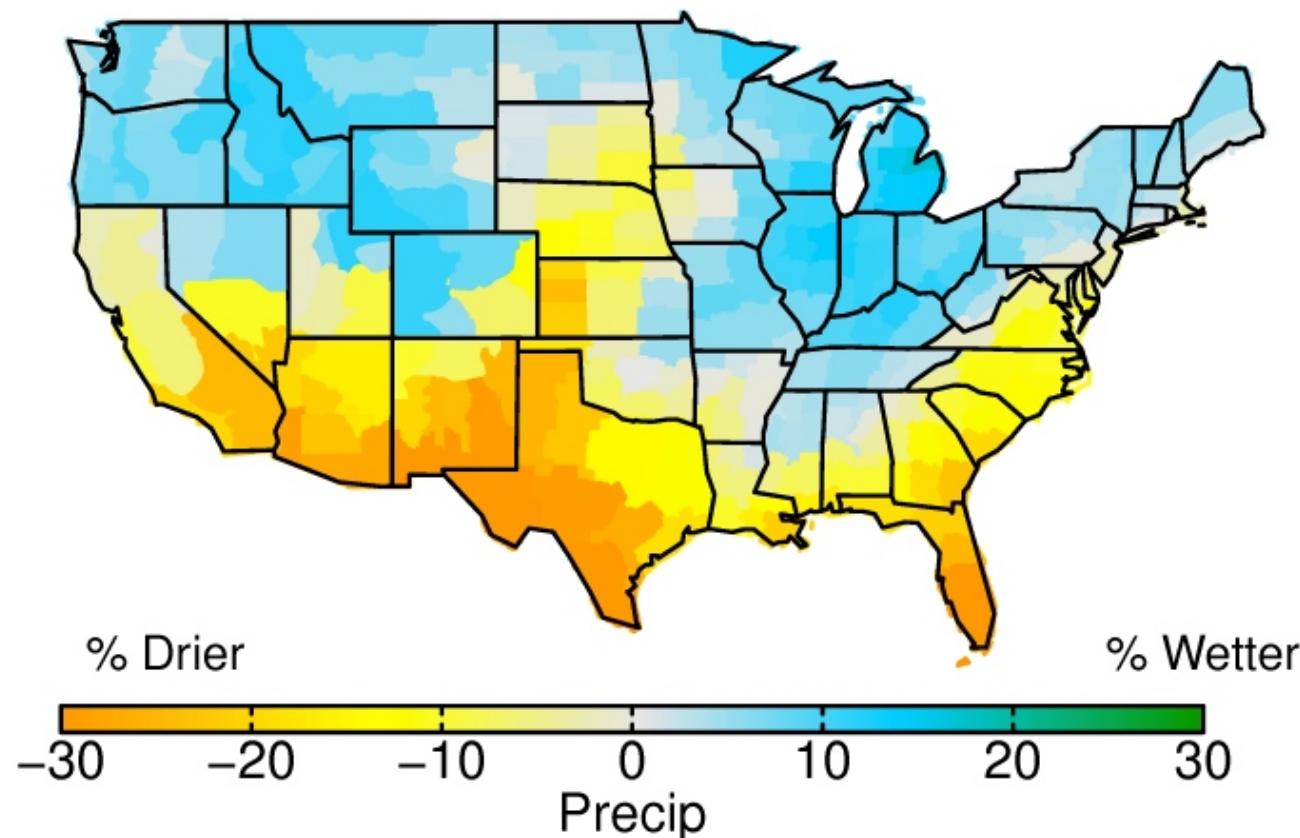


Figure courtesy of David W. Pierce (SIO)

Average Effect of La Niña on Winter Temperature

(Departure from normal winter, deg F)

Effect of La Niña Dec–Jan–Feb (deg–F)

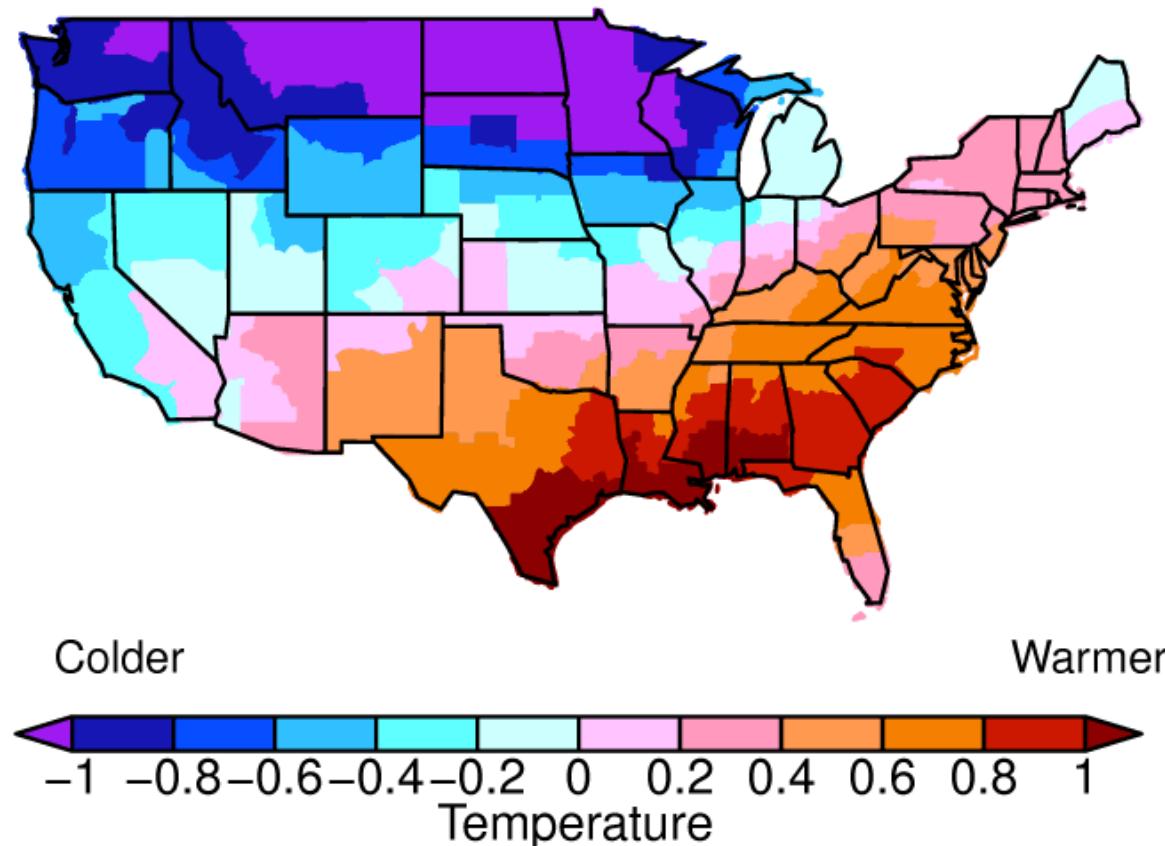


Figure courtesy of David W. Pierce (SIO)

Average La Niña vs. 4 Years of Drought

(Departure from normal for winter, %)

Average La Niña response

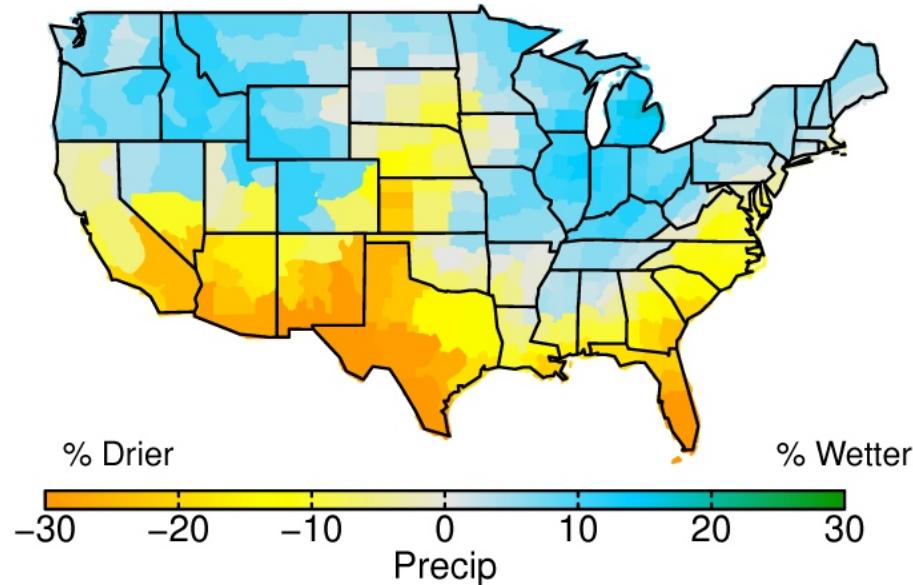
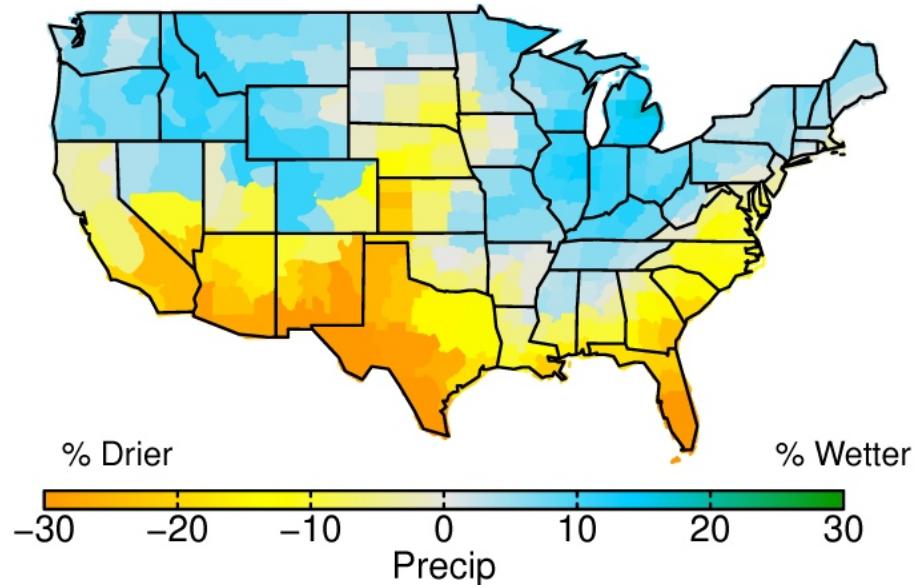


Figure courtesy of David W. Pierce (SIO)

Average La Niña vs. 4 Years of Drought

(Departure from normal for winter, %)

Average La Niña response



Drought, 2012-2015

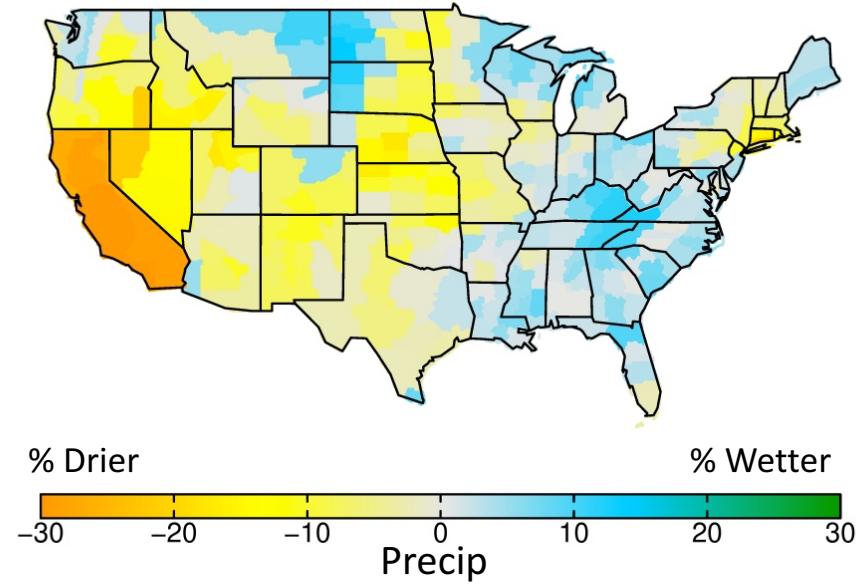


Figure courtesy of David W. Pierce (SIO)

ENSO Summary

- Observations and models suggest that tropical Pacific SST conditions will be colder than normal during this winter, but currently that cooling looks to be weak and may or may not reach the definition of La Nina.
- As of Sept 8th:
 - ENSO-Neutral conditions are slightly favored (between 55-60%) during the upcoming Northern Hemisphere fall and winter 2016-17
 - Current La Nina est: 39% chance
 - Little chance of El Nino continuing (4% chance)
- Current ocean conditions:
 - Not quite La Nina yet, but close to -0.5 °C threshold
 - Weaker than winter of 1998/1999 was in August

Drought Monitor September 2016

Intensity:



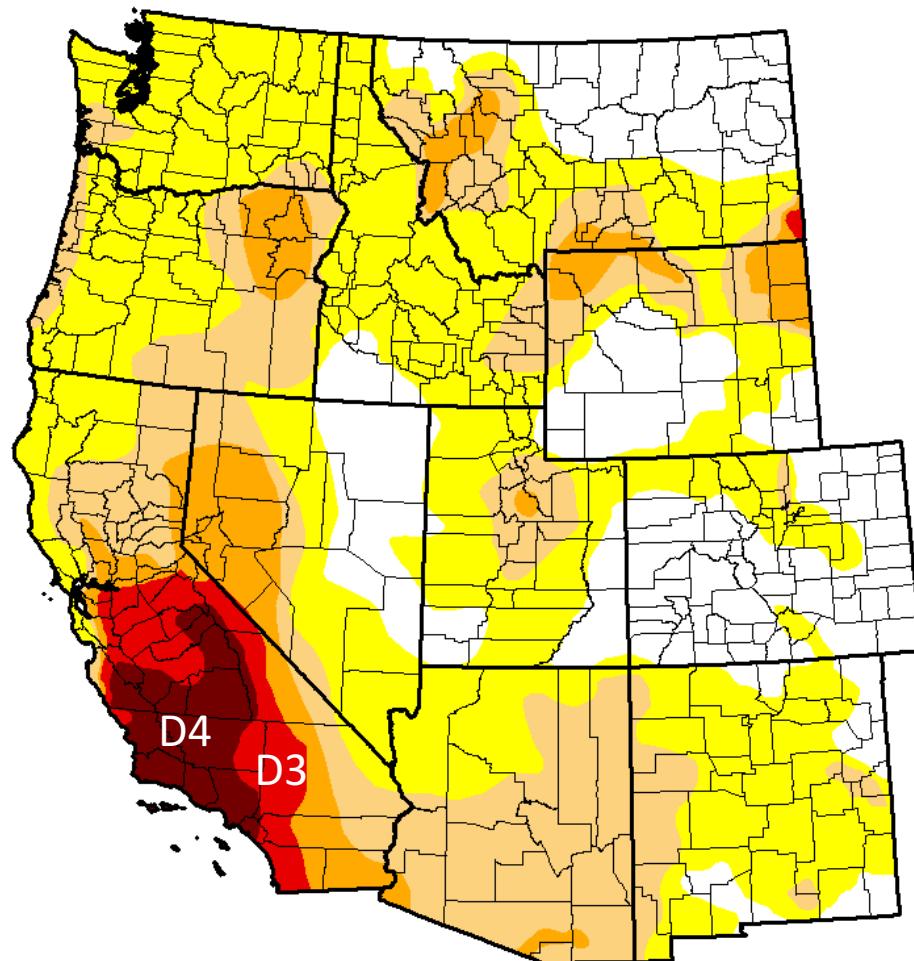
The Drought Monitor focuses on broad-scale conditions.
Local conditions may vary. See accompanying text summary
for forecast statements.

Author:

Brad Rippey
U.S. Department of Agriculture



<http://droughtmonitor.unl.edu/>



September 15, 2016

State of the Climate in California – Alex Tardy, NOAA meteorologist

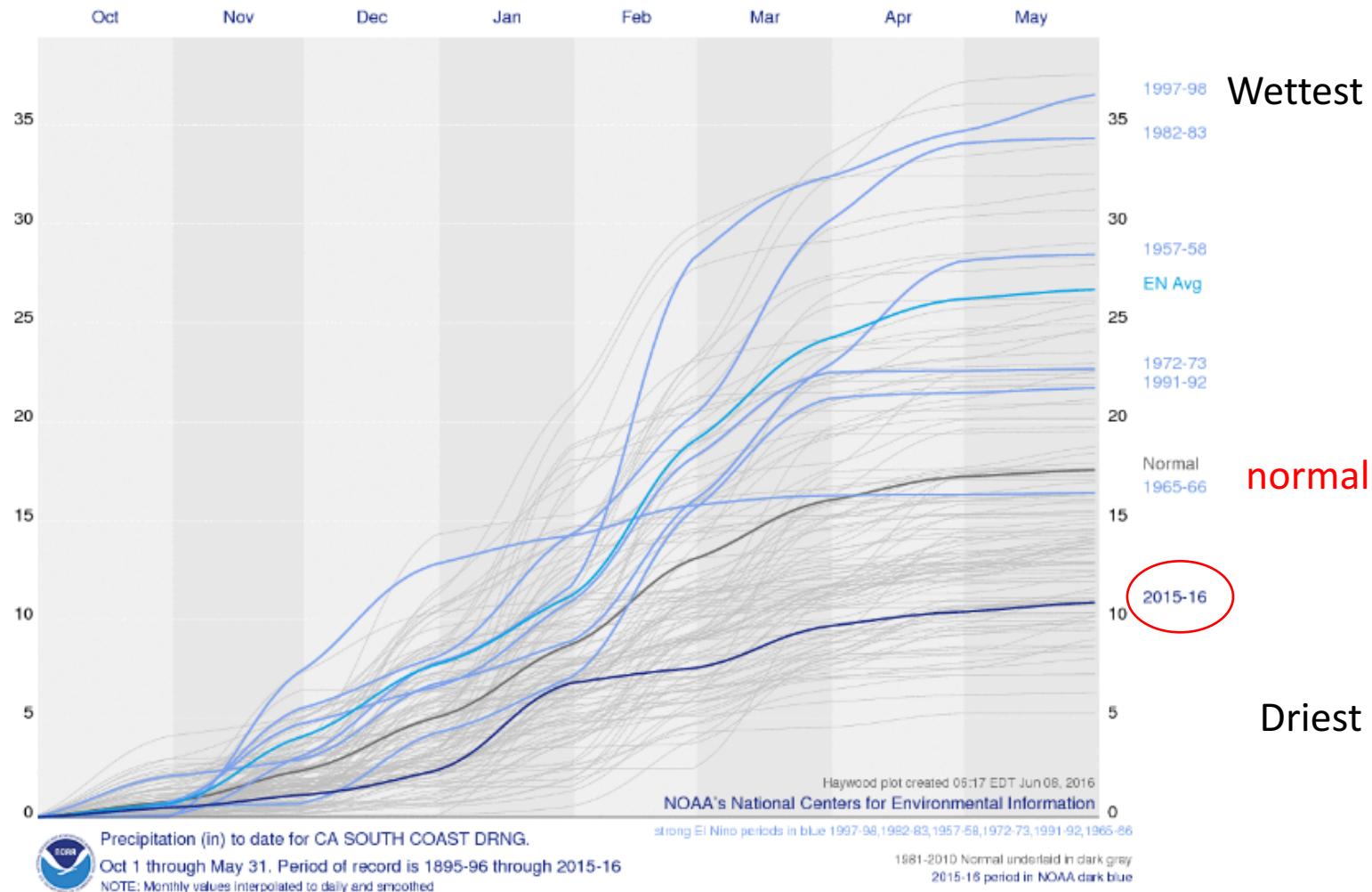
Seasonal precipitation

VERSION 1

State/District: California

Climate Division/City: CD 6. South Coast Drainage

[View Haywood Plot](#)



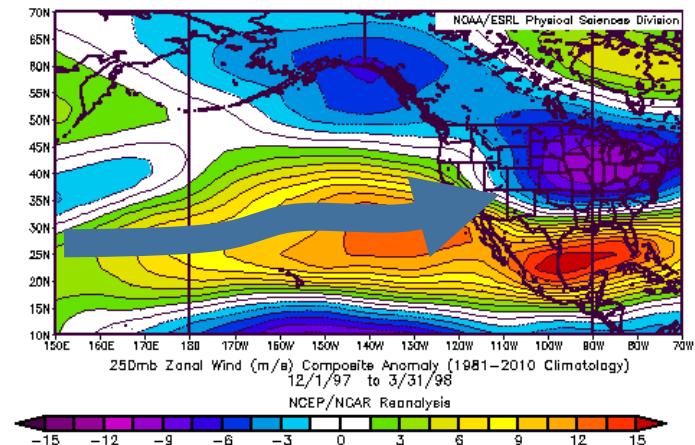
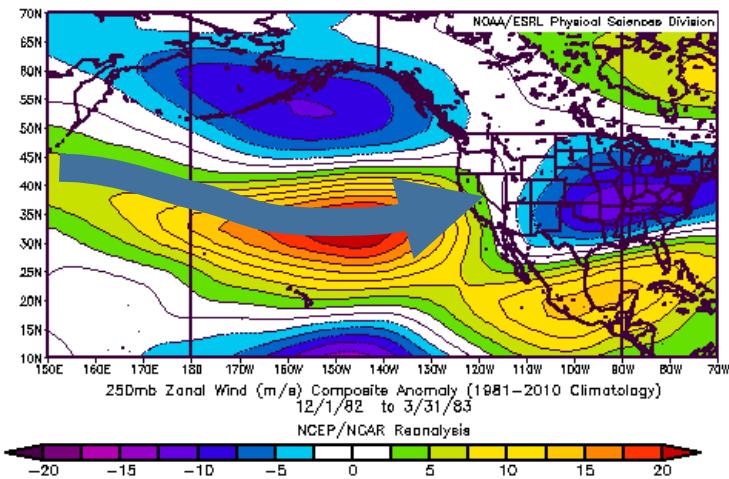
5 year precipitation since January 2011

September 13, 2016

Station 5 year precipitation	Total Deficit Calendar Year	2015-16 % Annual	30-y Annual average	Lost precipitation
San Diego (SAN)				
43.96	14.85 inches	7.86 or 76%	10.34	1 ½ seasons
Santa Ana (Fire stn)				
37.40	40.38 inches	5.19 or 38%	13.63	3 seasons
Riverside (Fire stn)				
36.58	22.60 inches	5.59 or 54%	10.33	2 seasons
Palomar Mtn				
114.10	59.15 inches	16.87 or 56%	30.20	2 seasons
Idyllwild				
109.55	48.01 inches	21.55 or 79%	27.41	1 ½ seasons
Palm Springs				
14.59	13.19 inches	3.59 or 74%	4.83	2 ½ seasons

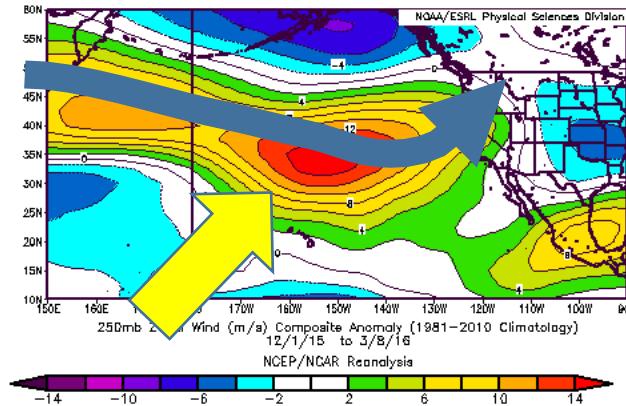
Jet zonal wind December 1 to March 31

1982-83 1997-98



Jet zonal wind 2015-16

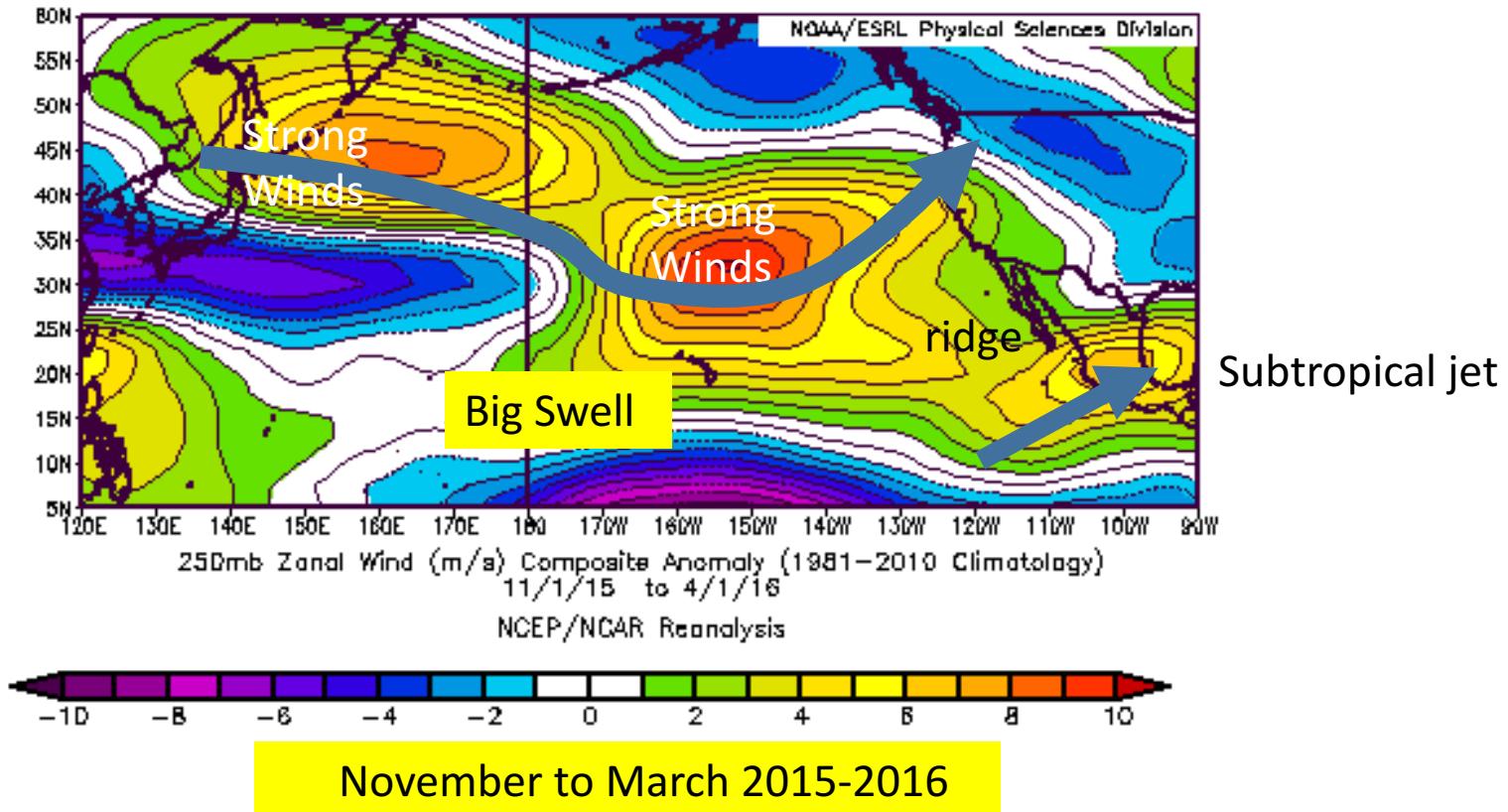
Northwesterly oriented JET
Unusually strong and westward
position of jet stream



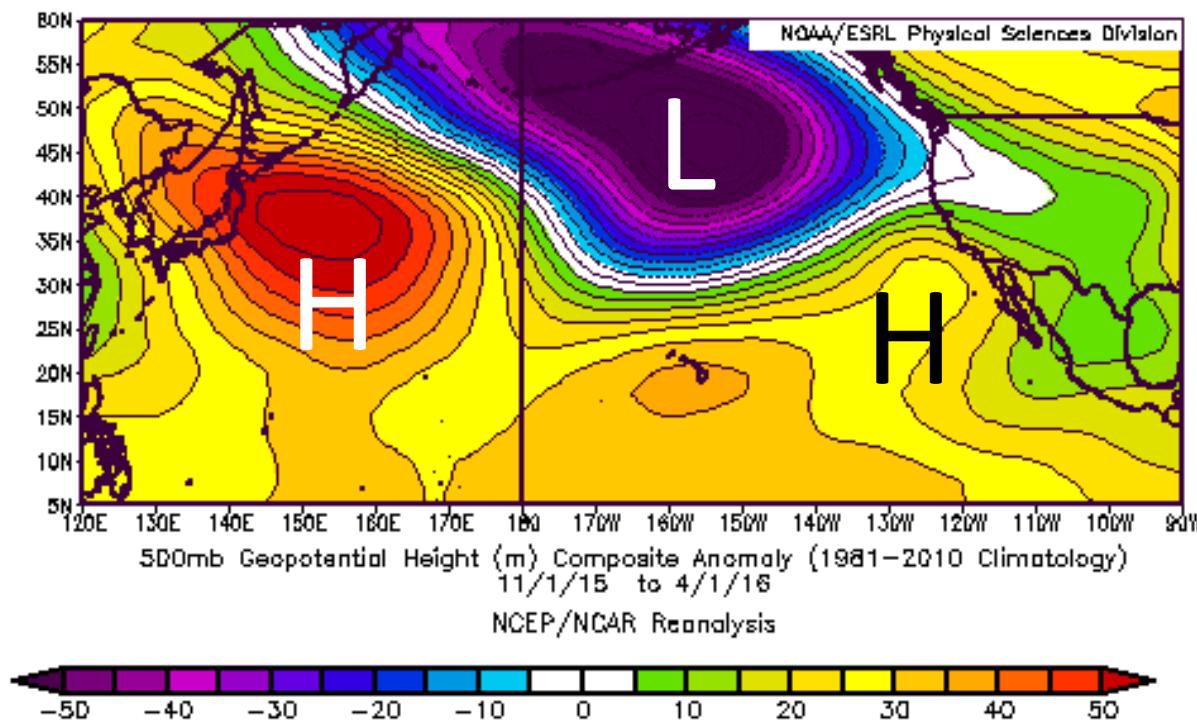
250 mb zonal wind 2015-16

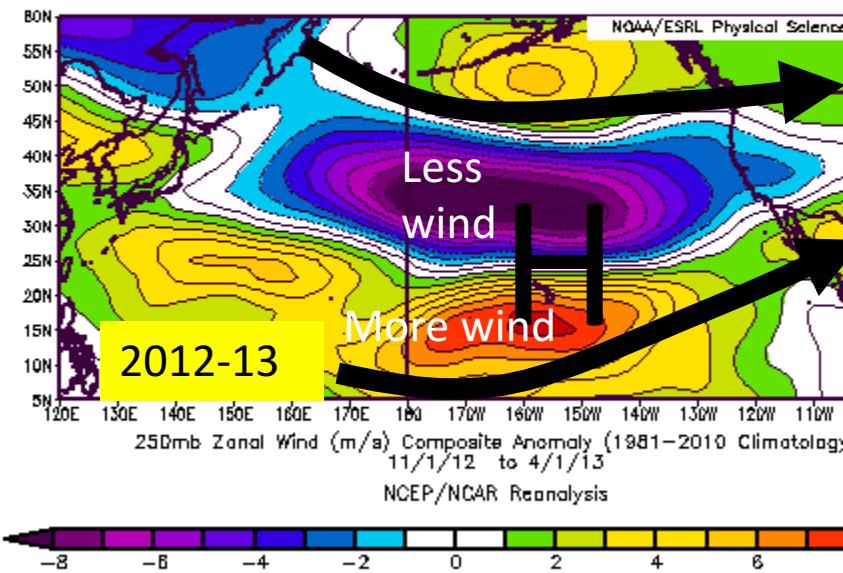
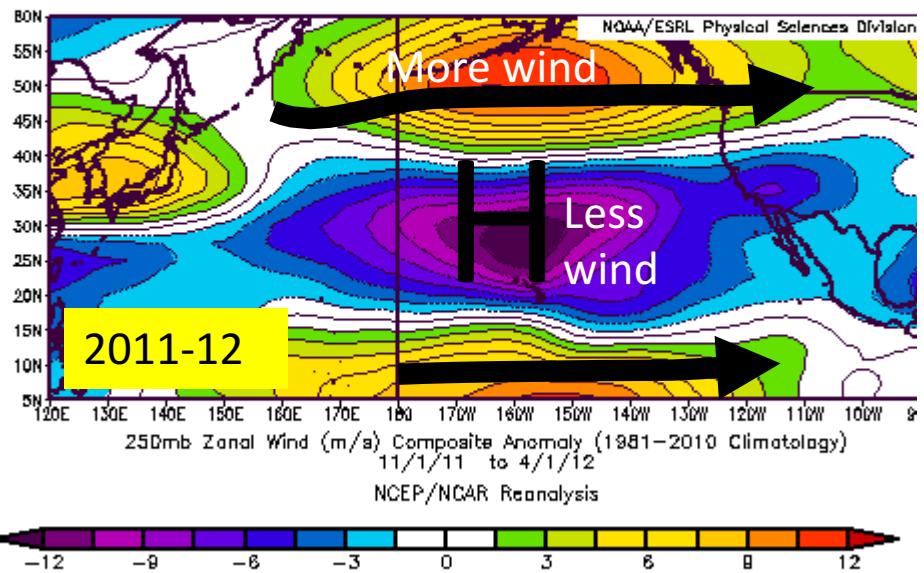
Departure from normal

Pacific Jet

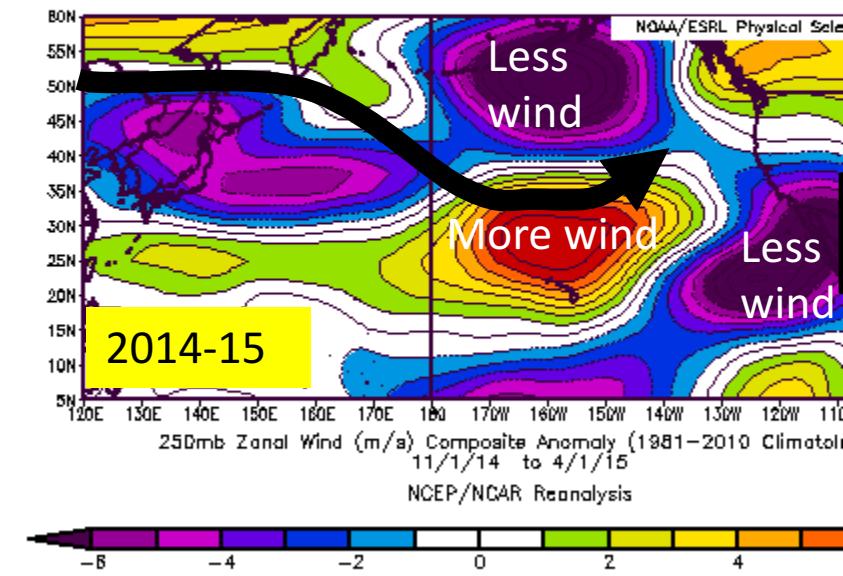
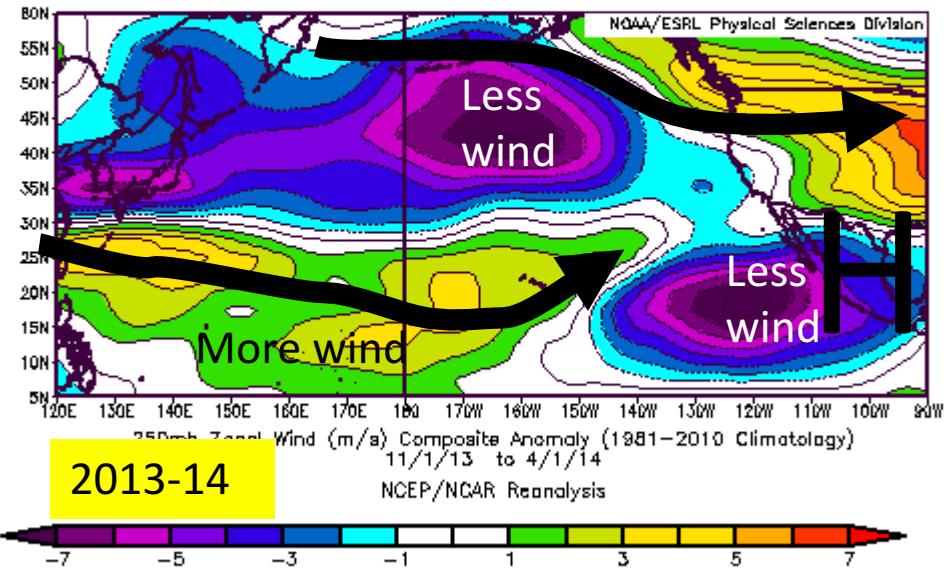


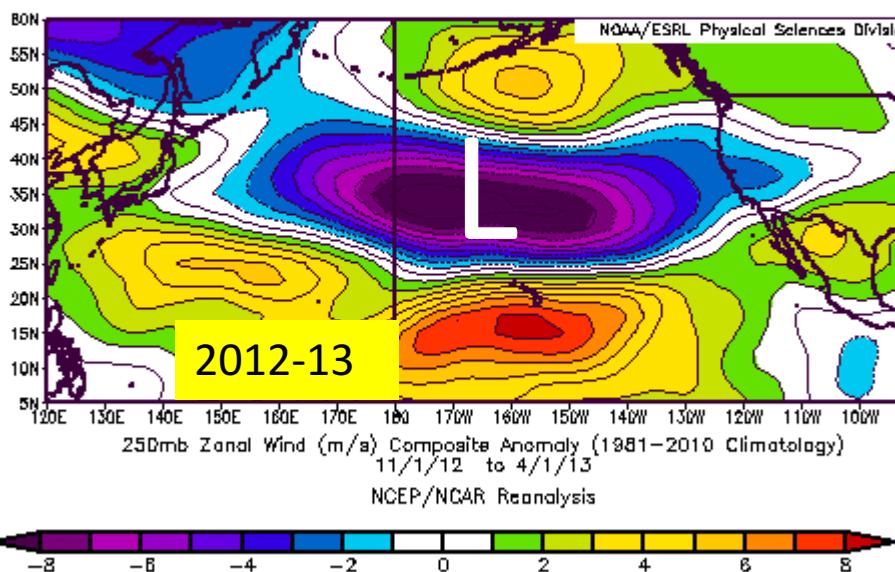
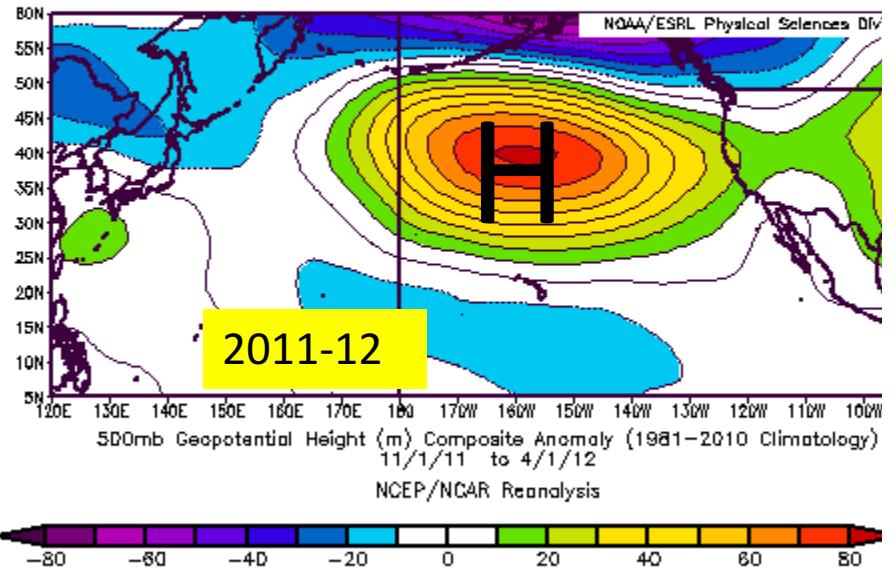
2015-16 pattern unusually deep long wave trough



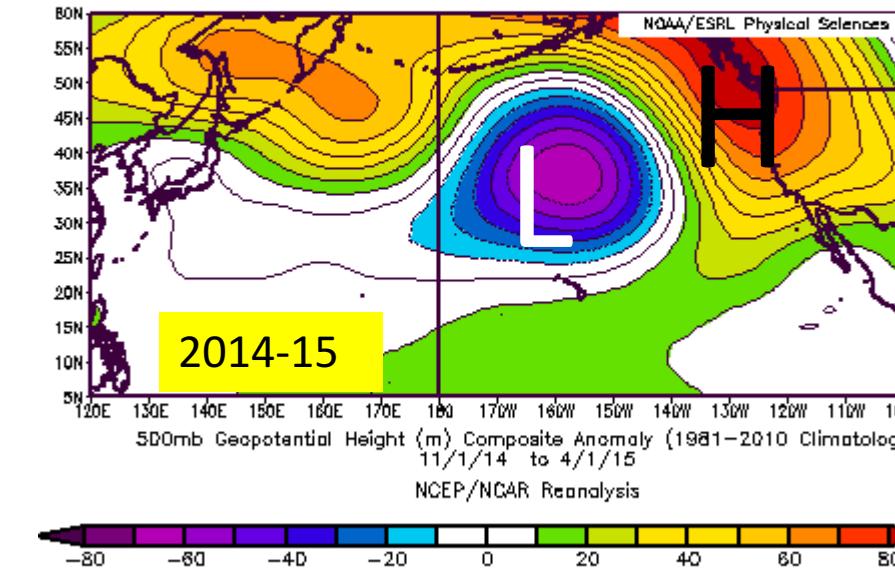
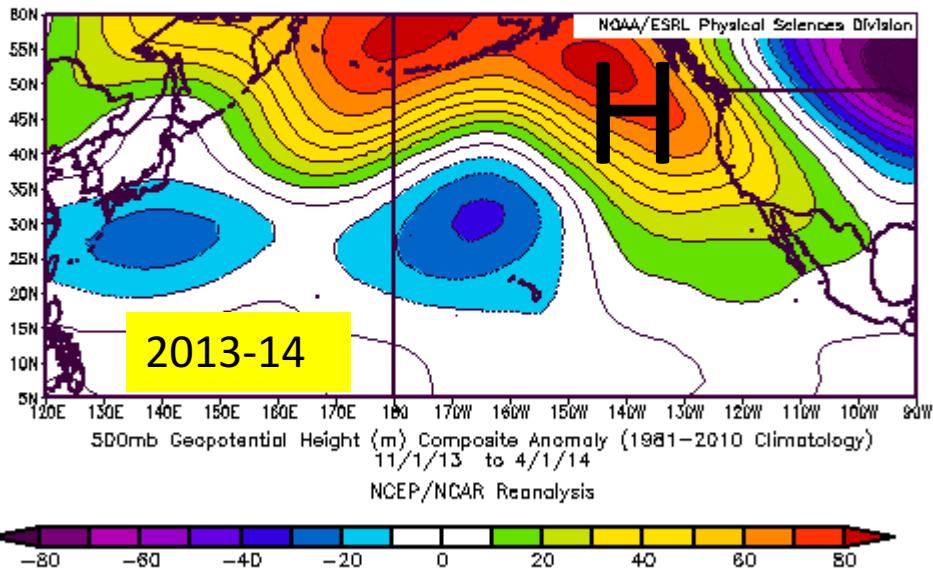


2011 to 2015 drought years atmospheric anomalies – 250 mb zonal wind

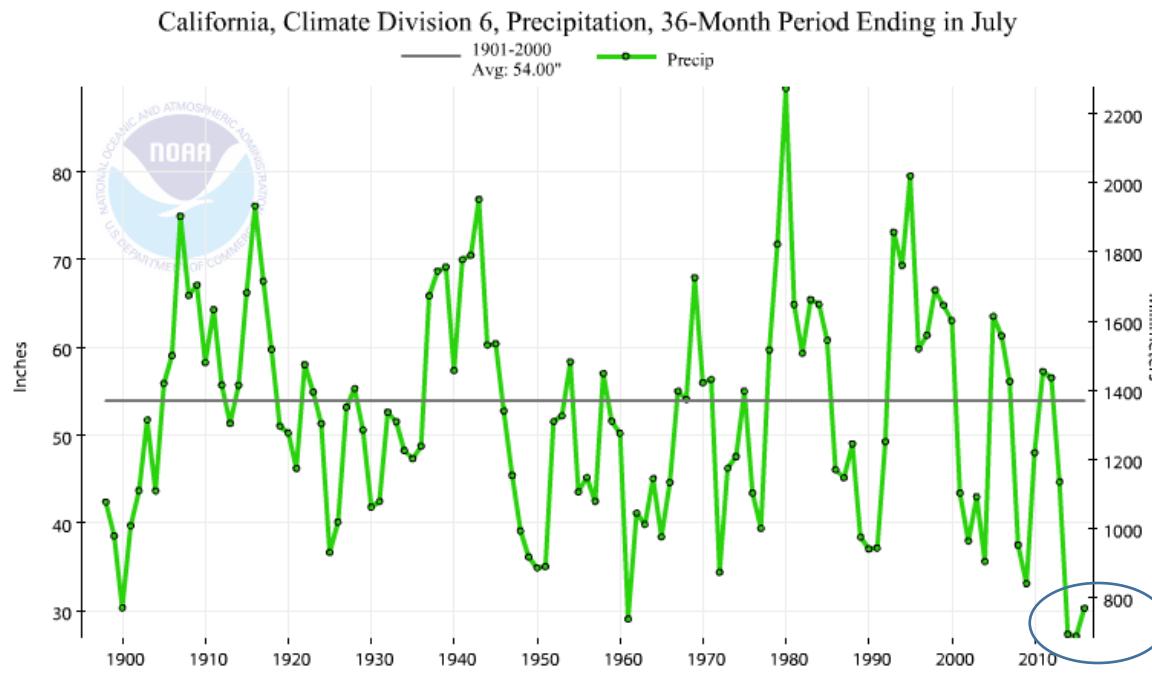




2011 to 2015 drought years atmospheric anomalies – 500 mb heights



Precipitation past 36 months



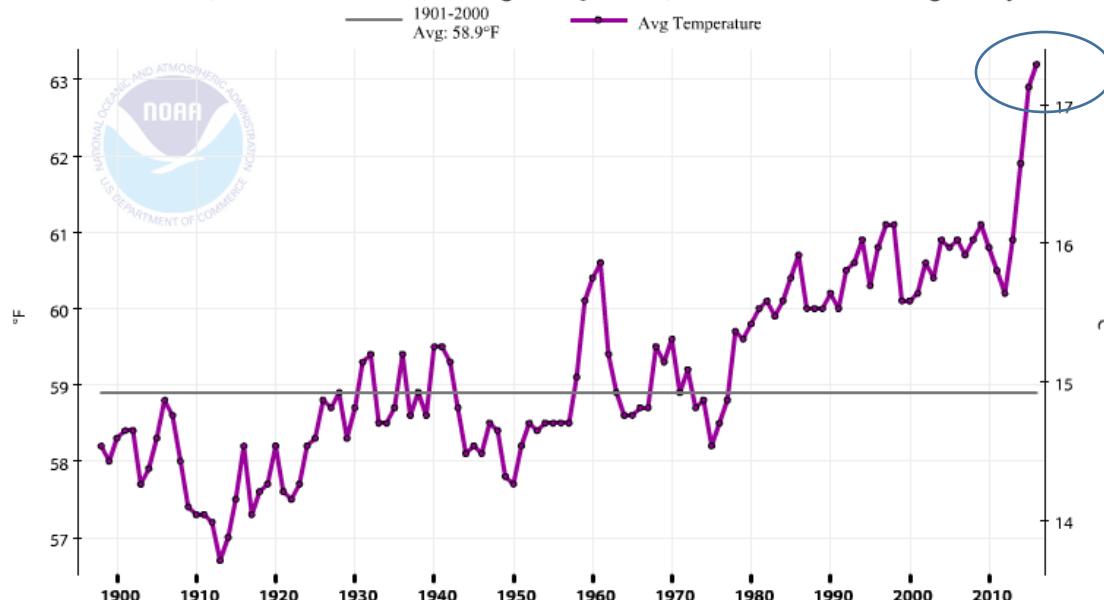
Download: [XML](#) [CSV](#) [GIF](#)

ANOMALY (54.00") 1901-2000 BASE PERIOD					
	DATES	VALUE	RANK		
2012-15	201208 - 201507	27.09"	1		
	201108 - 201407	27.33"	2		
2013-16	195808 - 196107	29.05"	3		
	201308 - 201607	30.31"	4	-23.69"	
	189708 - 190007	30.34"	5	-23.66"	
	200608 - 200907	33.09"	6	-20.91"	

Past 36 months – warmest on record

Move mouse towards an axis until highlighted. Left-click mouse to pan. Shift key + left-click to zoom.

California, Climate Division 6, Average Temperature, 36-Month Period Ending in July

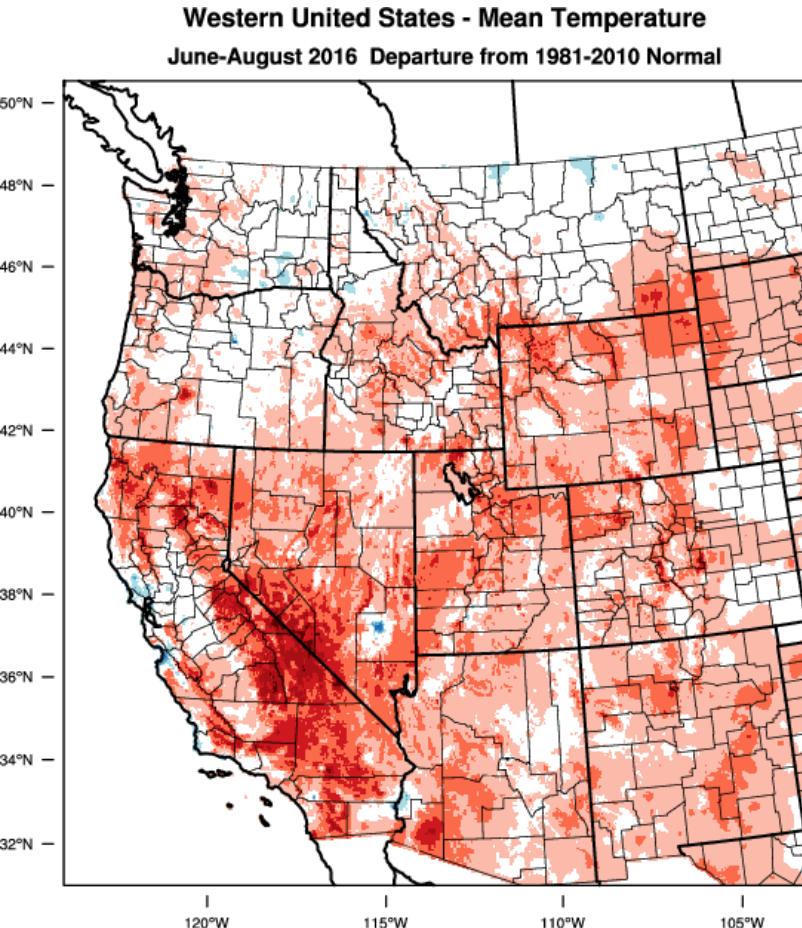


Download: [XML](#) [CSV](#) [RSS](#)

DATES		VALUE	RANK	ANOMALY (58.9°F) 1901-2000 BASE PERIOD
2013-2016	201308 - 201607	63.2°F	119	4.3°F
	201208 - 201507	62.9°F	118	4.0°F
	201108 - 201407	61.9°F	117	3.0°F
	199408 - 199707	61.1°F	116	2.2°F
	199508 - 199807	61.1°F	116	2.2°F

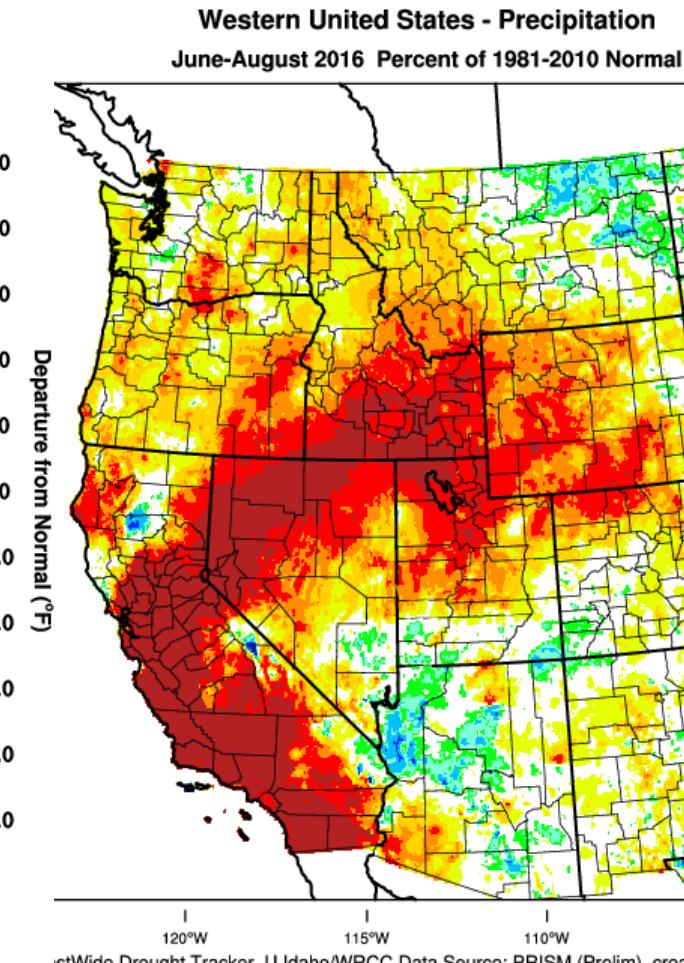
June to August 2016

Temperature departure



Near normal coast and above
normal mountains and deserts

Percent of Normal precipitation



Much below normal monsoon
precipitation in California

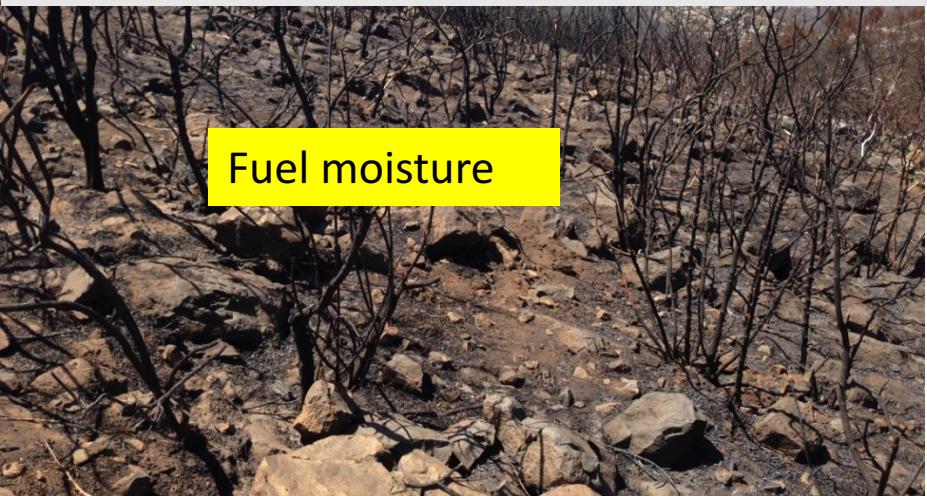
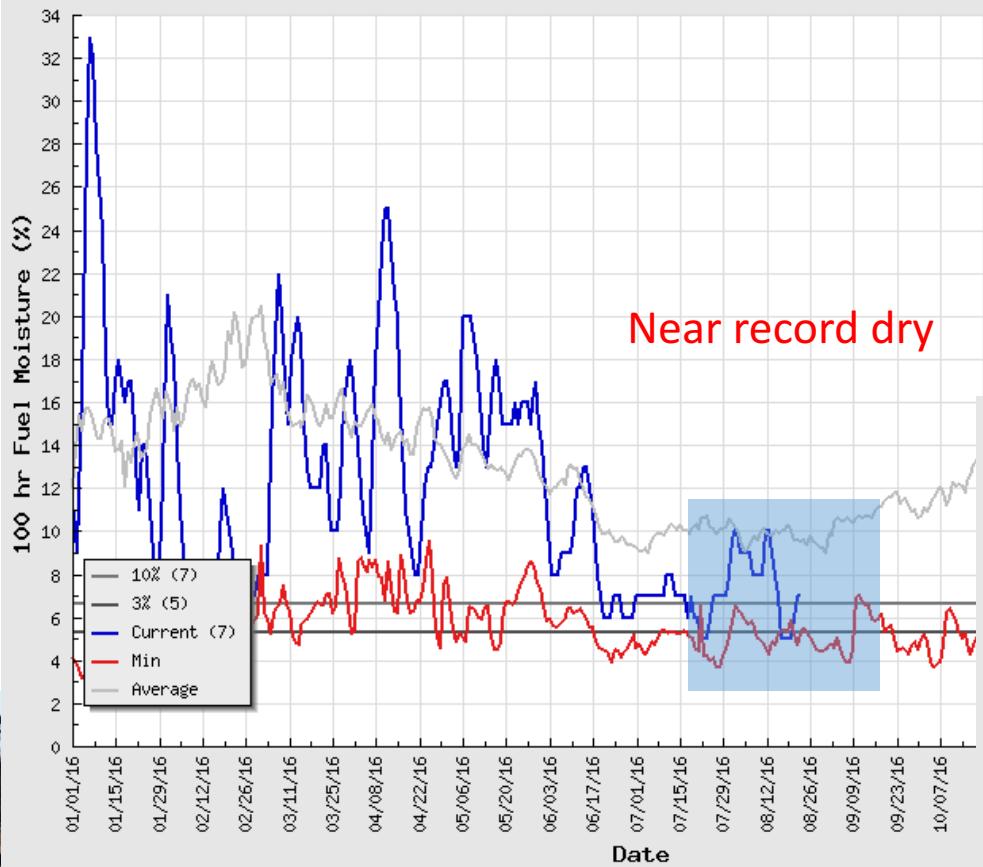
June 18 to 20, 2016 extreme high temperatures

Location	Saturday	Sunday	Monday
Yorba Linda	98	108	109
Lake Forest	95	104	109
Santa Ana	94	103	107
San Diego SAN	80	88	86
Ontario	99	111	112
Riverside Arpt	101	111	114
Lake Elsinore	97	107	115
Escondido	94	103	106
Ramona	97	106	109
El Cajon	95	104	107
Palomar Mt	84	93	96
Alpine	96	106	107
Wrightwood	81	89	92
Hesperia	95	104	108
Palm Springs	106	118	122
Thermal	109	119	121
Borrego Springs	109	117	122*

Red = record for date

DESCANSO – Descanso Fire Station (045707)

Valid Date: 23-Aug-2016

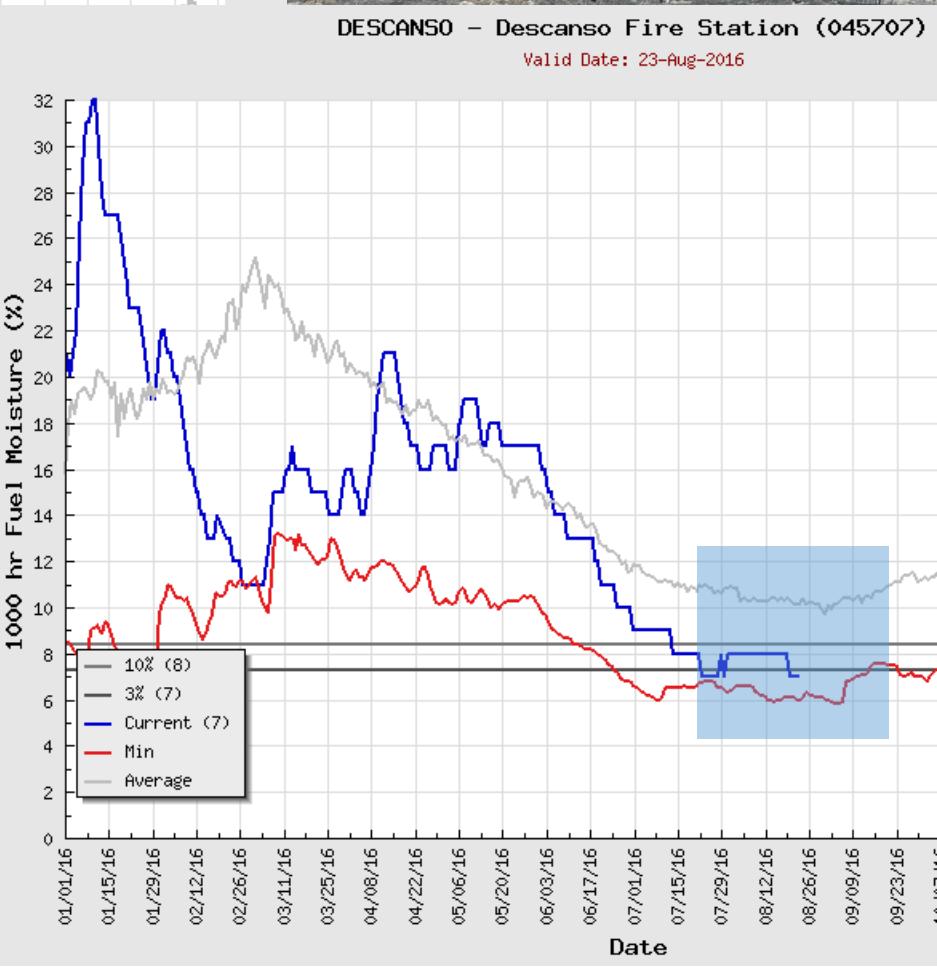


Fuel moisture

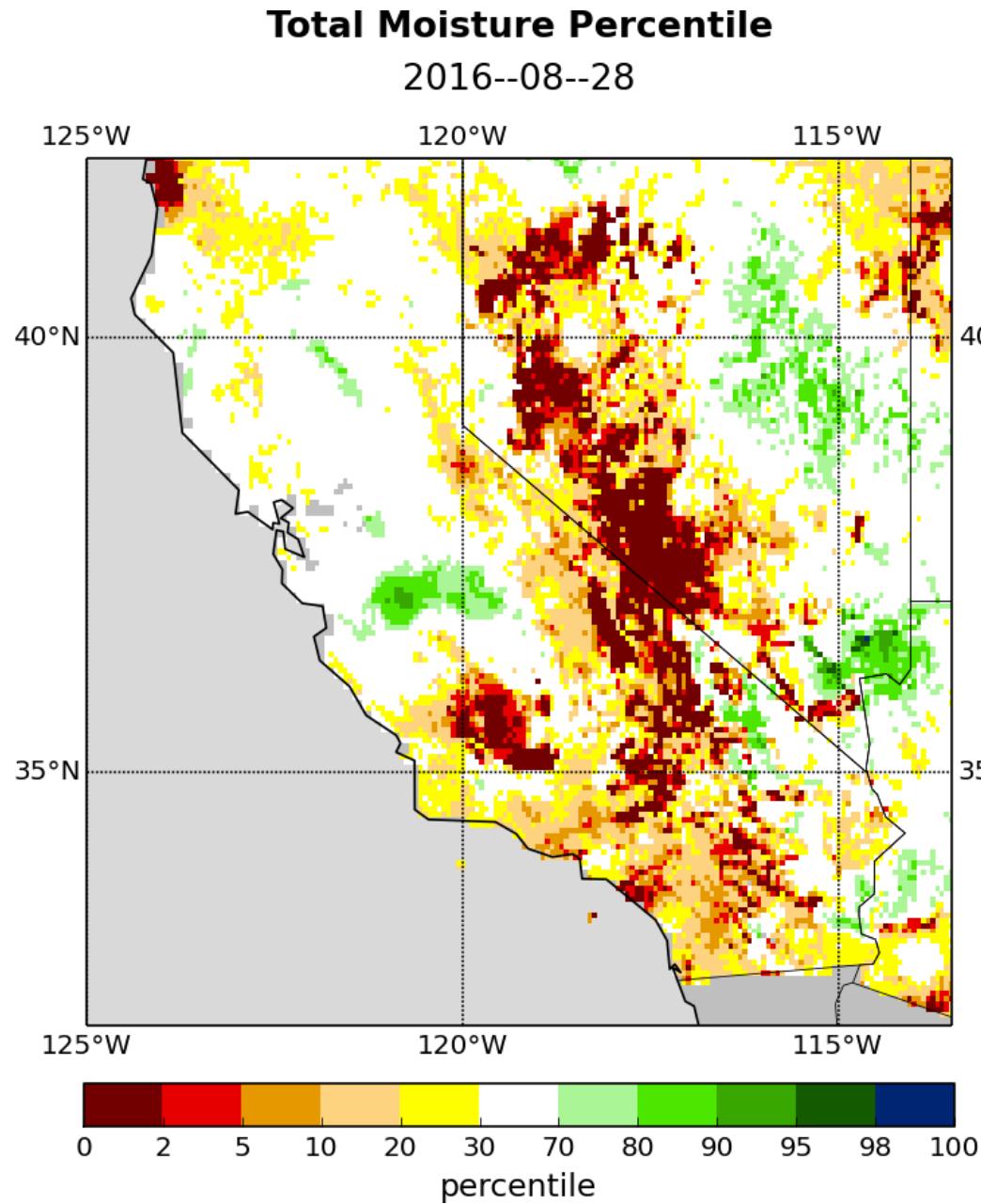


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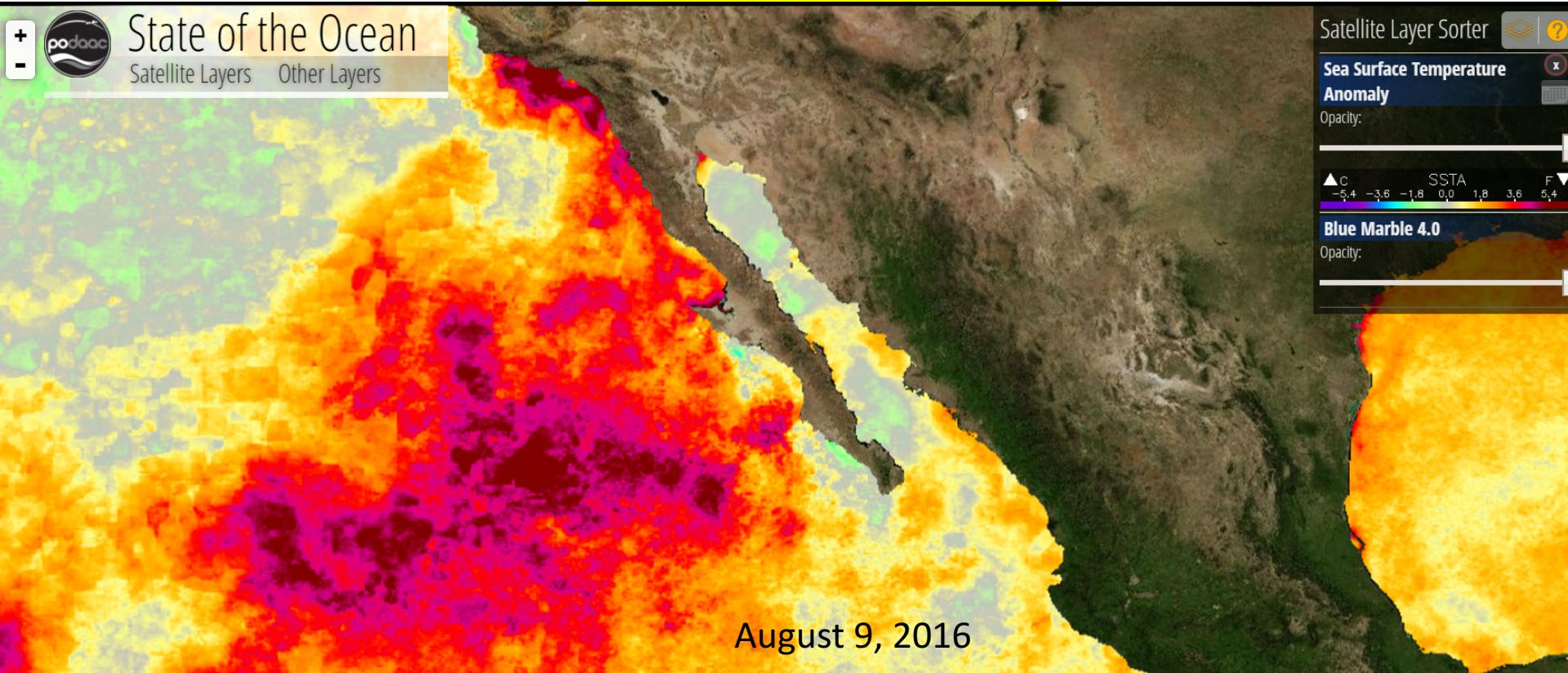


Hydro.ucla.edu/monitor_ca/index.html



Warm Ocean Sea Surface Temperature Anomaly

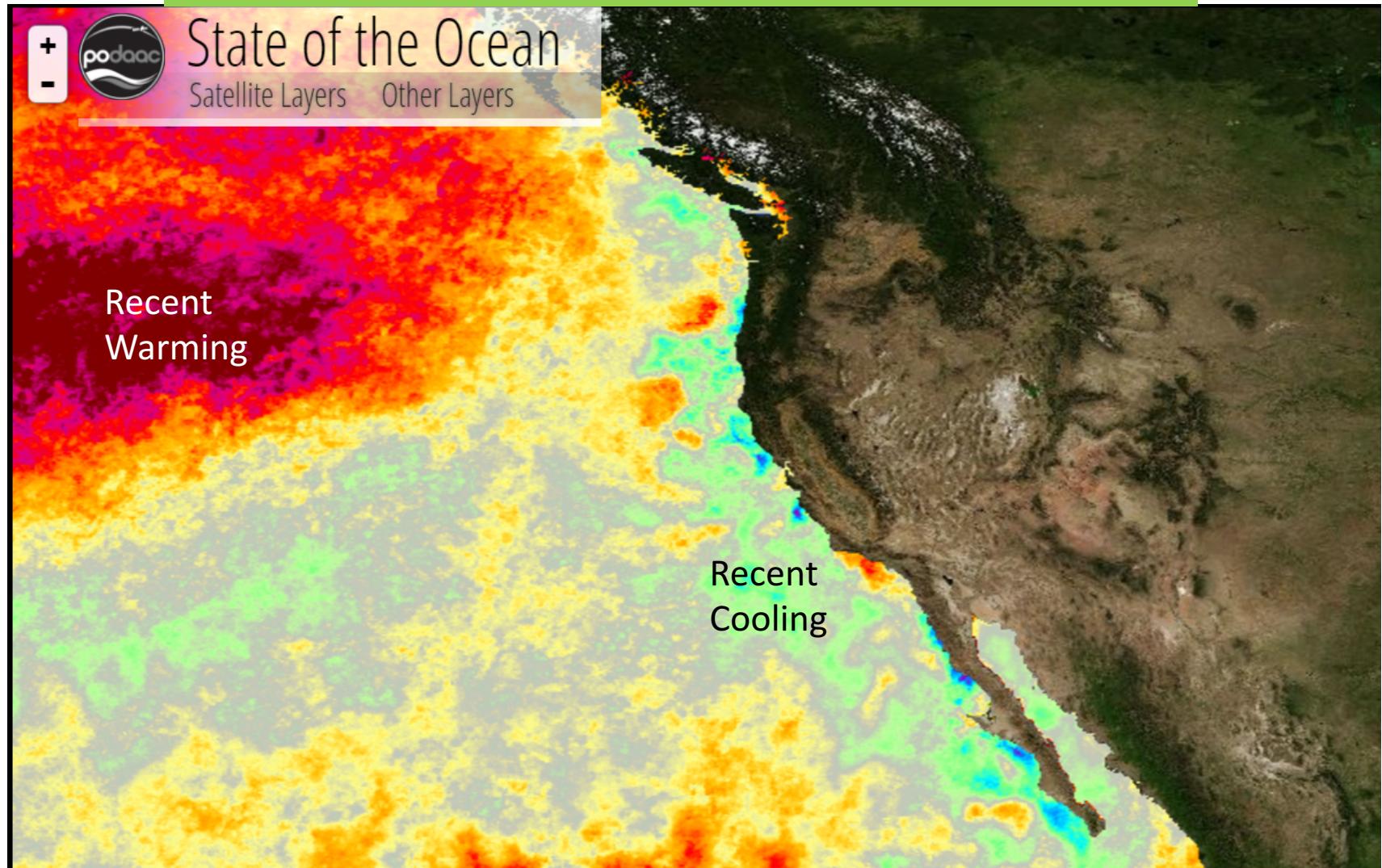
Average July temperature at La Jolla was 72 F with a peak of 77.4 F



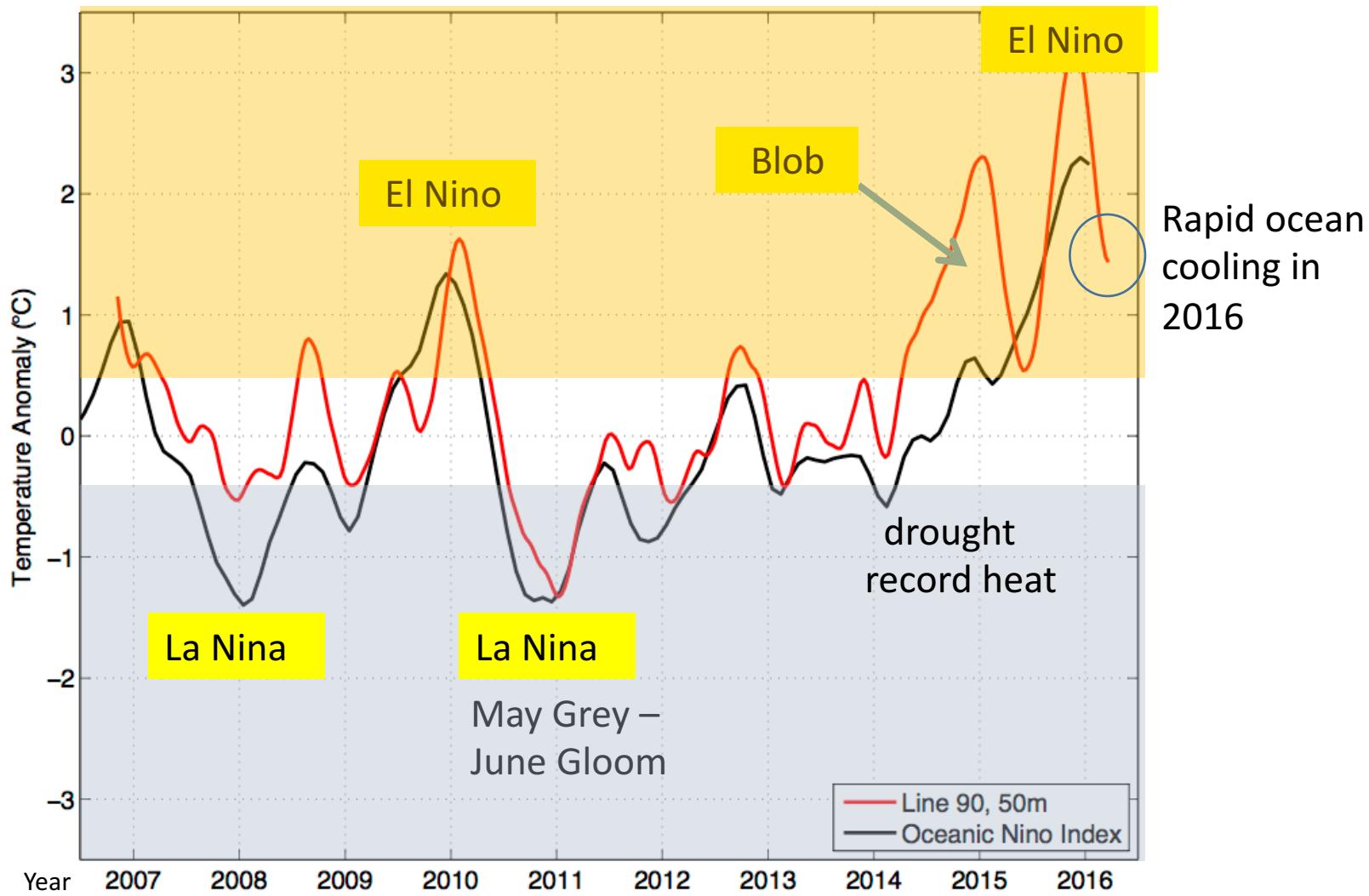
Warmer coastal temperature can cause warmer overnight low temperatures, higher humidity and less cooling in the daytime heat

September 12, 2016

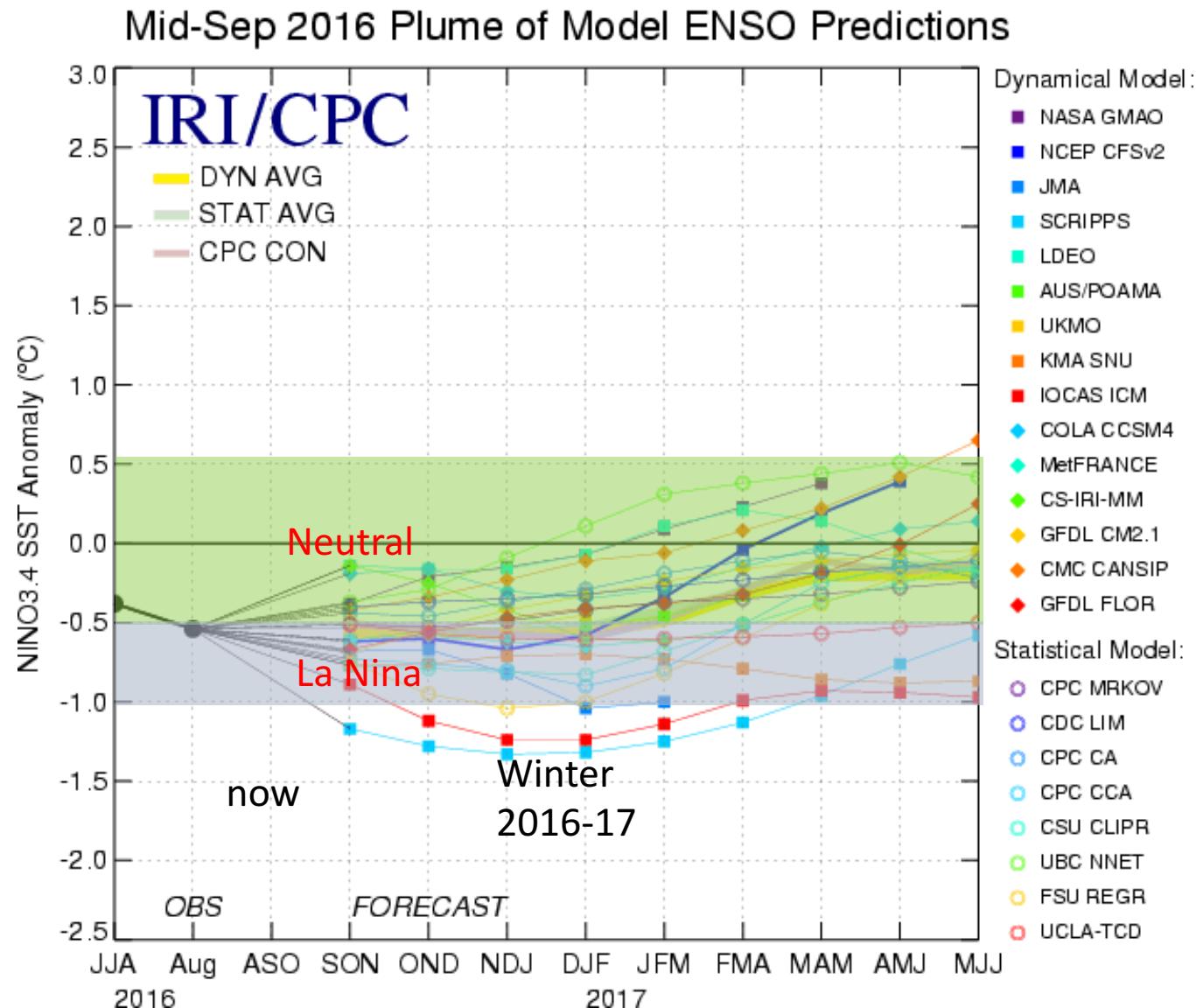
Cooling (below normal) occur along the West Coast this summer from north to south and coastal areas had normal average air temperatures



Ocean Temperatures Oceanic Nino Index and CA Bight



Weak La Nina or Neutral ENSO favored



Water Year Neutral ENSO	ENSO ONI (NDJ)	October- April	PDO (DEC)	AO (DJF)
2003-04	0.4	5.18	0.38	0.36
2001-02	-0.1	2.99	-0.93	-0.18
1996-97	-0.4	7.65	-0.03	-0.14
1993-94	0.2	9.82	1.07	0.92
1992-93	0.2	17.81	0.53	0.60
1989-90	0.4	11.77	-2.23	1.30
1988-89	-0.1	6.23	-0.21	1.67
1985-86	-0.4	13.90	0.38	-0.63
1981-82	-0.1	11.42	0.67	0.03
1980-81	-0.1	8.06	-0.1	-0.33
1979-80	0.5	14.96	-0.42	-0.42
1978-79	-0.1	14.73	-0.43	-0.28
1966-67	-0.3	10.42	-0.32	-0.85
1961-62	-0.4	8.88	-2.69	0.47
1960-61	-0.2	3.39	0.17	-1.22
1959-60	-0.2	7.24 9.65	0.86	-1.18



San Diego Big Monthly Rainfall



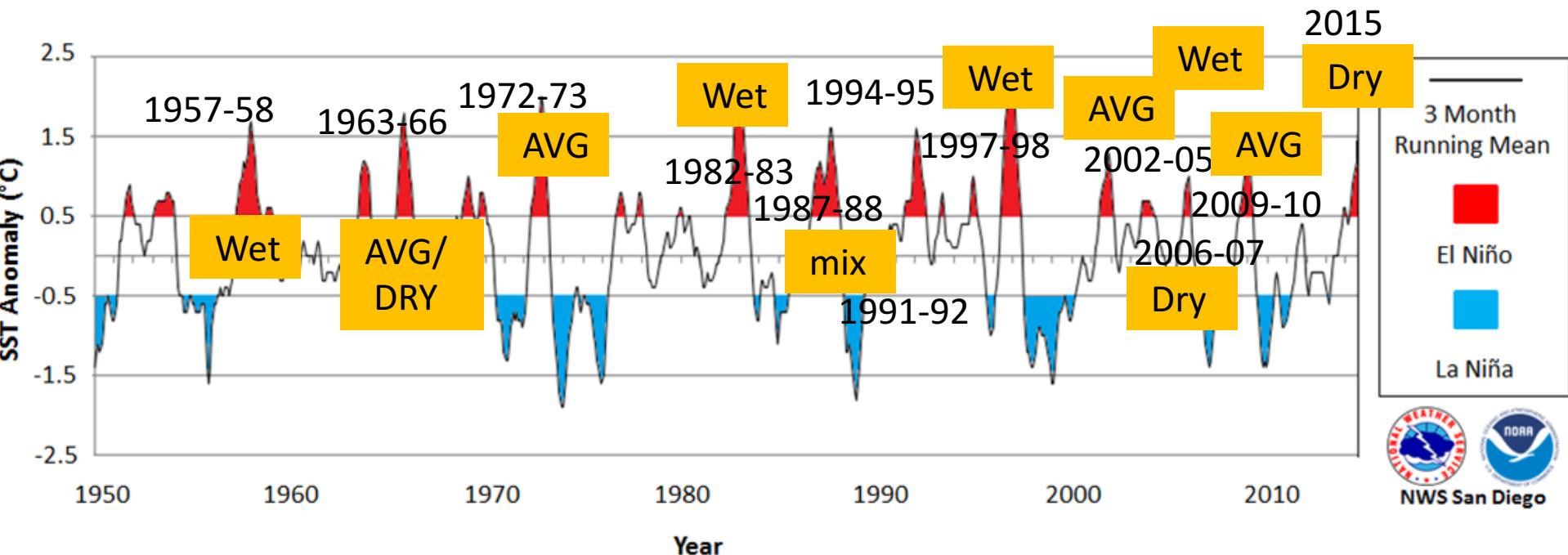
Winter October to April

Month Year	Total Precipitation	October-April	ENSO ONI
January 1993	9.09	17.81	0.2 (neutral)
January 1995	8.06	16.63	1.3
February 1998	7.65	16.19	2.5
March 1991	6.96	11.77	0.4 (neutral)
March 1983	6.57	17.87	2.3
December 1965	6.60	14.74	1.5
January 1978 Drought Buster Year	5.95	16.54	0.7
February 2005	5.83	22.35	0.7
January 1979	5.82	14.03	-0.1 (neutral)
November 1965	5.82	14.74	1.5
January 1980	5.58	14.96	0.5
December 2010	5.00	12.18	-1.4

2010-11

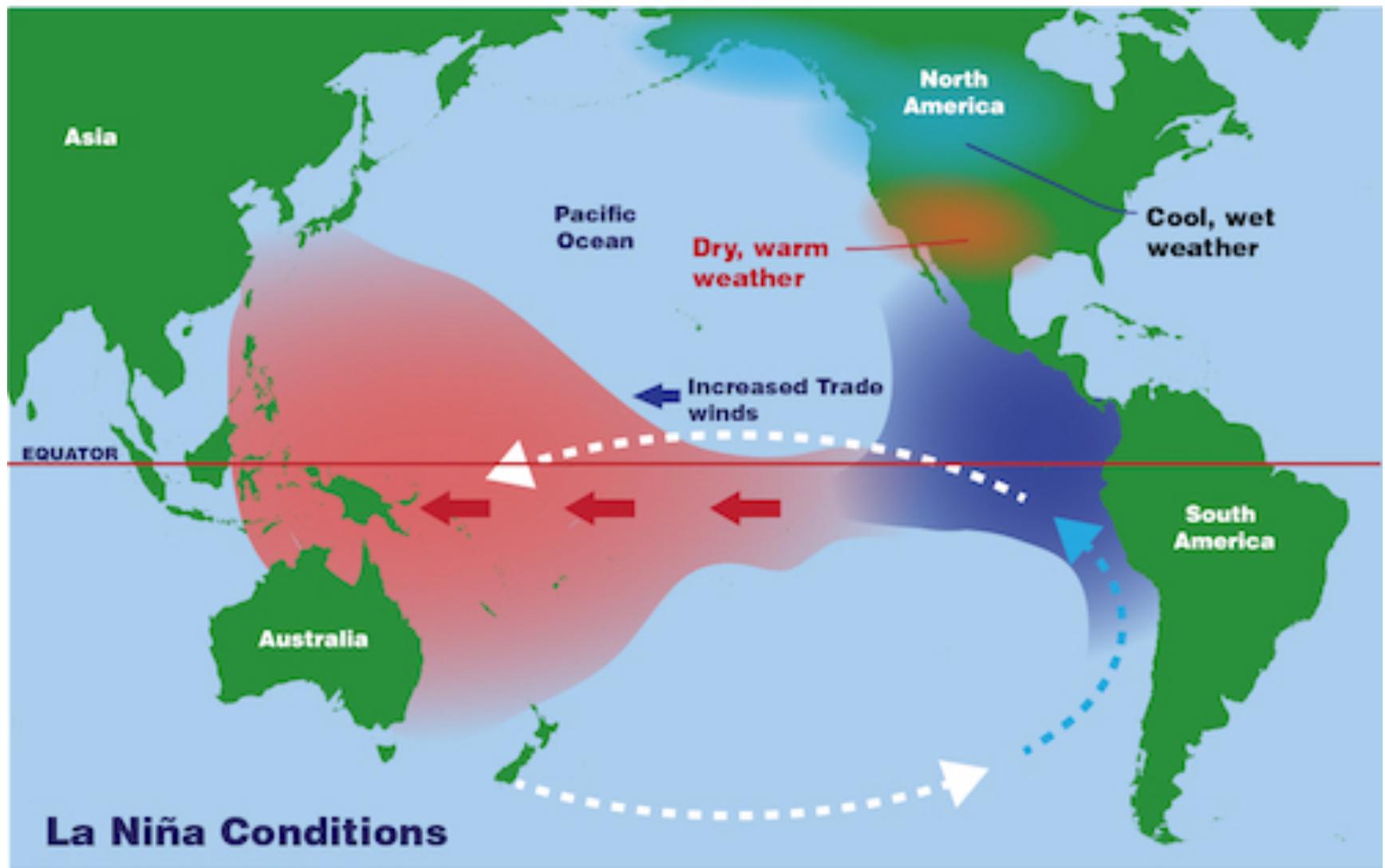
Historical ENSO periods

El Nino warm = red blue=cool phase

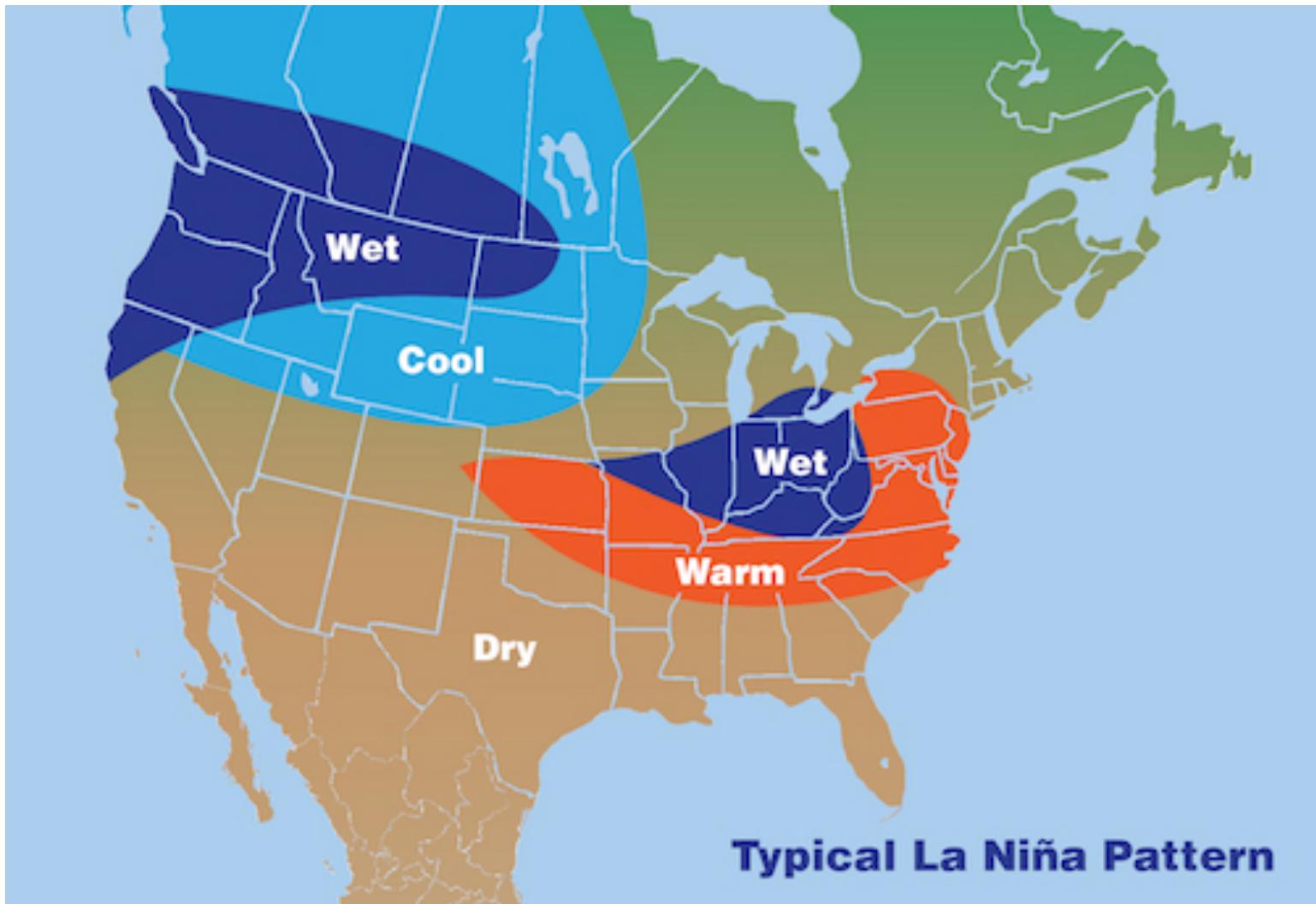


2010-11 Wet

What is the La Niña pattern?

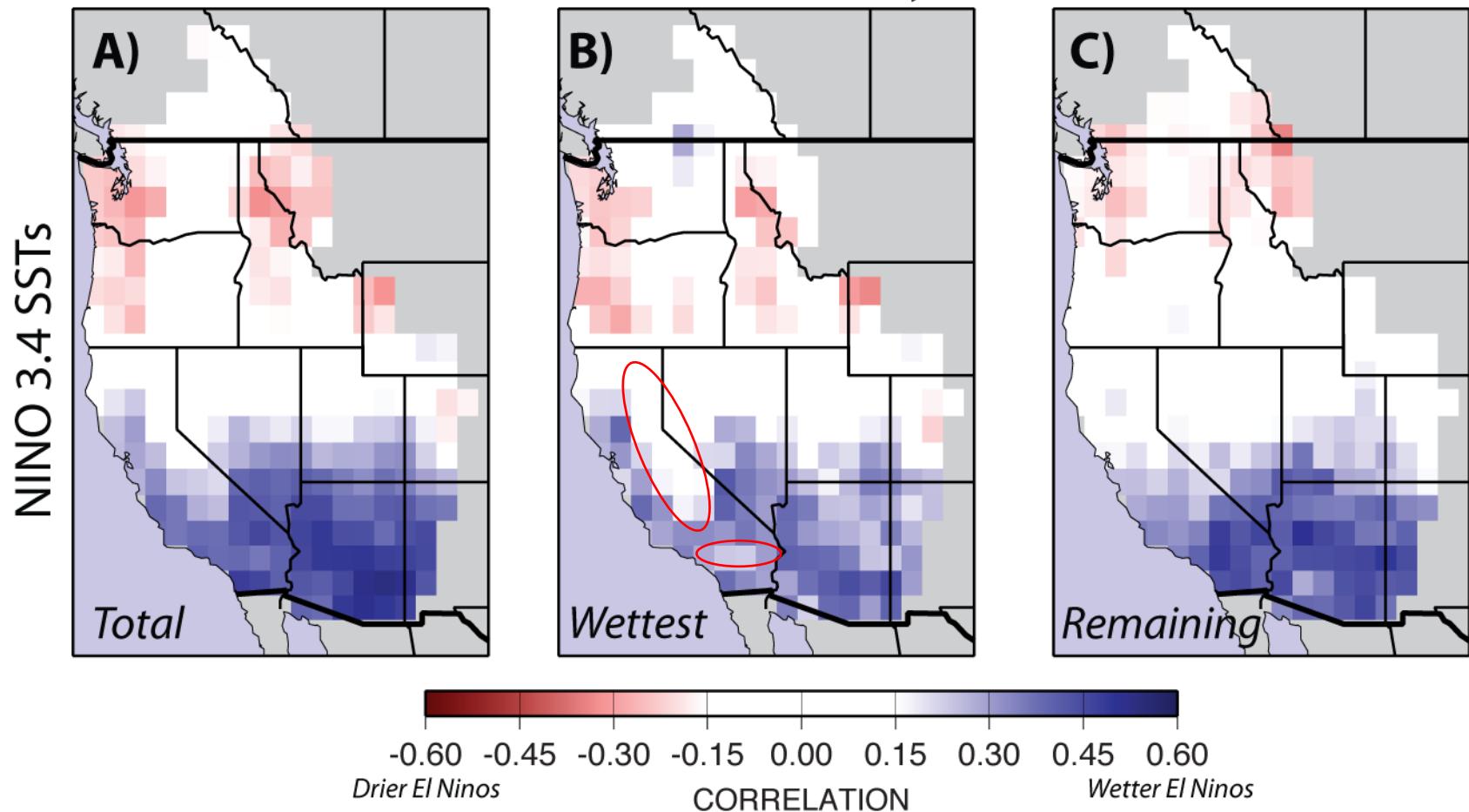


Typical La Niña Impact to Weather



Atmospheric River major events can be any year

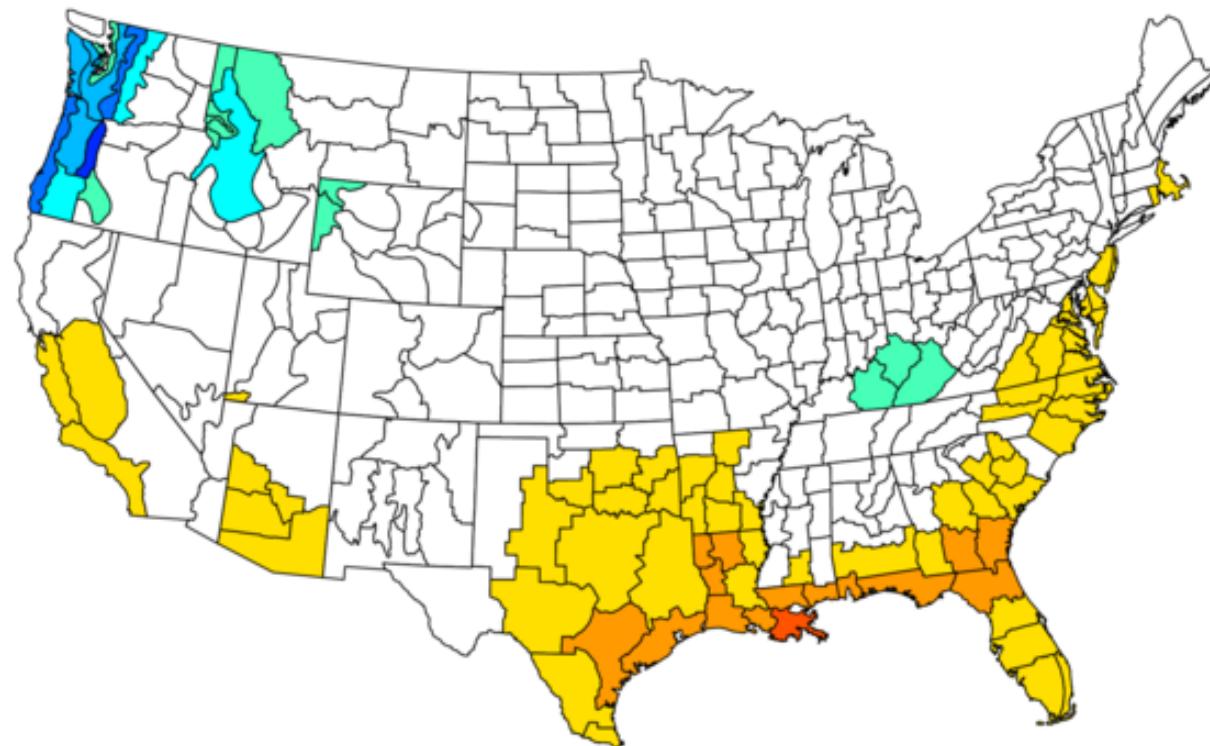
RELATIONS BETWEEN NINO3.4 SSTs & TOTAL PRECIP, CONTRIBUTIONS FROM WETTEST 5% OF WET DAYS, AND REMAINING DAYS, 1916-2011



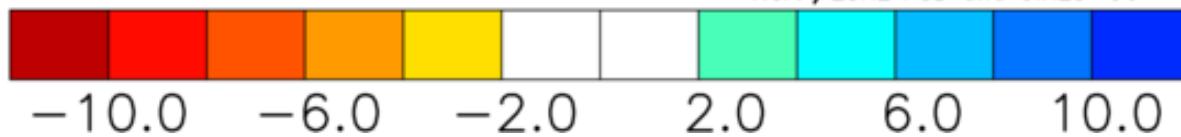
Credit: Scripps Institution of Oceanography

NOAA/NCDC Climate Division Composite Precipitation Anomalies (in)
Versus 1981–2010 Longterm Average

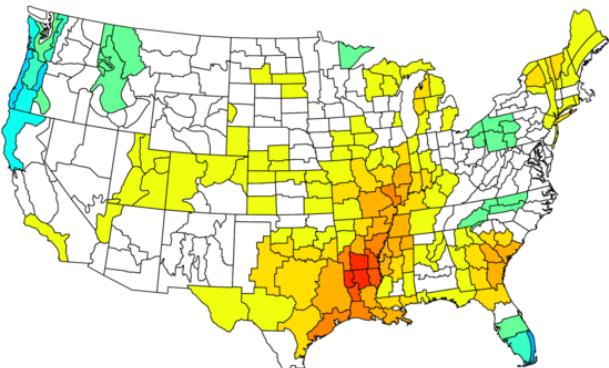
Oct to Apr 1950–51, 1954–55, 1955–56, 1964–65, 1970–71, 1971–72, 1973–74, 1974–75
1975–76, 1984–85, 1988–89, 1995–96, 1998–99, 1999–00, 2000–01, 2007–08, 2010–11, 2011–12,



NOAA/ESRL PSD and CIRES-CU



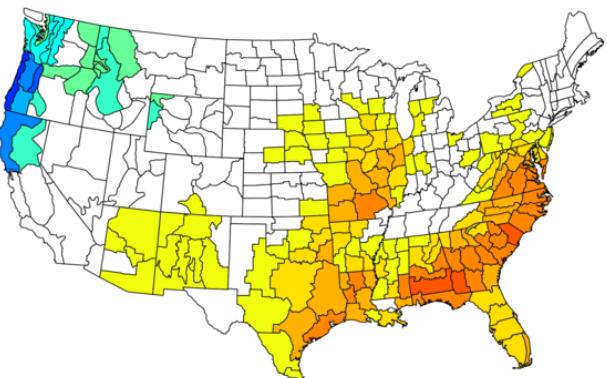
NOAA/NCDC Climate Division Composite Precipitation Anomalies (in)
Versus 1981–2010 Longterm Average
Oct 1950,1954,1955,1964,1970,1971,1973,1974,1975,1984
1988,1995,1998,1999,2000,2007,2010,2010,2011



October

NOAA/ESRL PSD and CIRES-CU
-2.00 -1.50 -1.00 -0.50 0.00 0.50 1.00 1.50 2.00
NOAA/NCDC Climate Division Composite Precipitation Anomalies (in)
Versus 1981–2010 Longterm Average
Jan 1951,1955,1956,1965,1971,1972,1974,1975,1976,1985
1989,1996,1999,2000,2001,2008,2011,2012

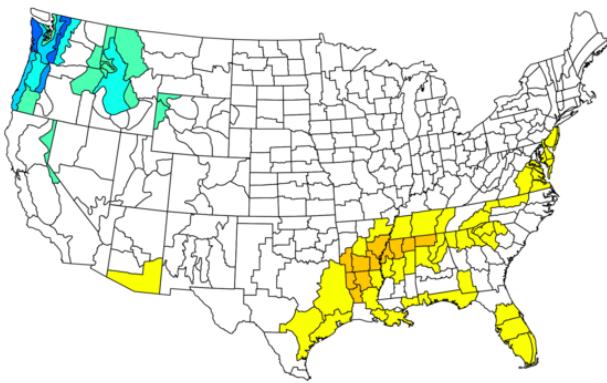
NOAA/NCDC Climate Division Composite Precipitation Anomalies (in)
Versus 1981–2010 Longterm Average
Nov 1950,1954,1955,1964,1970,1971,1973,1974,1975,1984
1988,1995,1998,1999,2000,2007,2010,2011



November

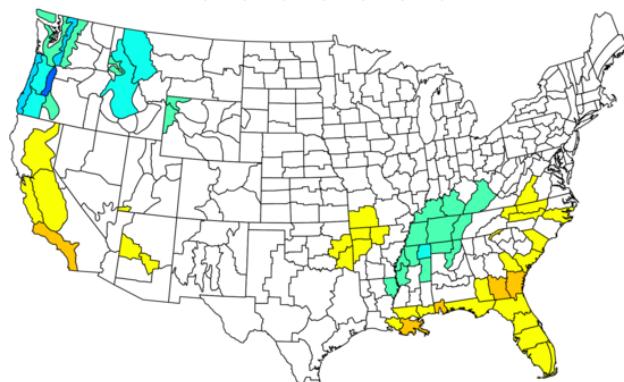
NOAA/ESRL PSD and CIRES-CU
-2.00 -1.50 -1.00 -0.50 0.00 0.50 1.00 1.50 2.00
NOAA/NCDC Climate Division Composite Precipitation Anomalies (in)
Versus 1981–2010 Longterm Average
Feb 1951,1955,1956,1965,1971,1972,1974,1975,1976,1985
1989,1996,1999,2000,2001,2008,2011,2012

NOAA/NCDC Climate Division Composite Precipitation Anomalies (in)
Versus 1981–2010 Longterm Average
Dec 1950,1954,1955,1964,1970,1971,1973,1974,1975,1984
1988,1995,1998,1999,2000,2007,2010,2011



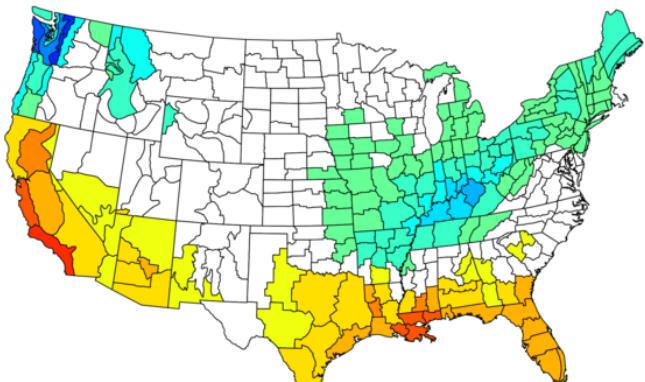
December

NOAA/ESRL PSD and CIRES-CU
-3.0 -2.0 -1.0 0.0 1.0 2.0 3.0
NOAA/NCDC Climate Division Composite Precipitation Anomalies (in)
Versus 1981–2010 Longterm Average
Mar 1951,1955,1956,1965,1971,1972,1974,1975,1976,1985
1989,1996,1999,2000,2001,2008,2011,2012



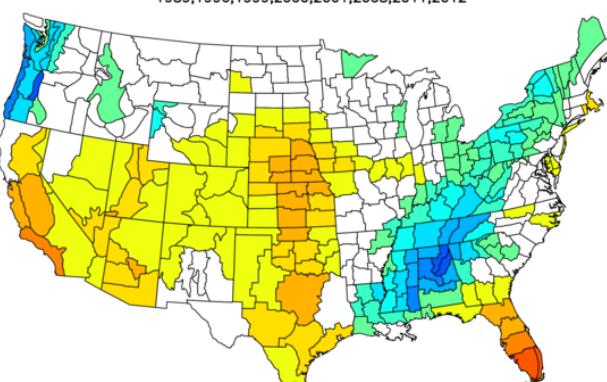
January

NOAA/ESRL PSD and CIRES-CU
-3.0 -2.0 -1.0 0.0 1.0 2.0 3.0



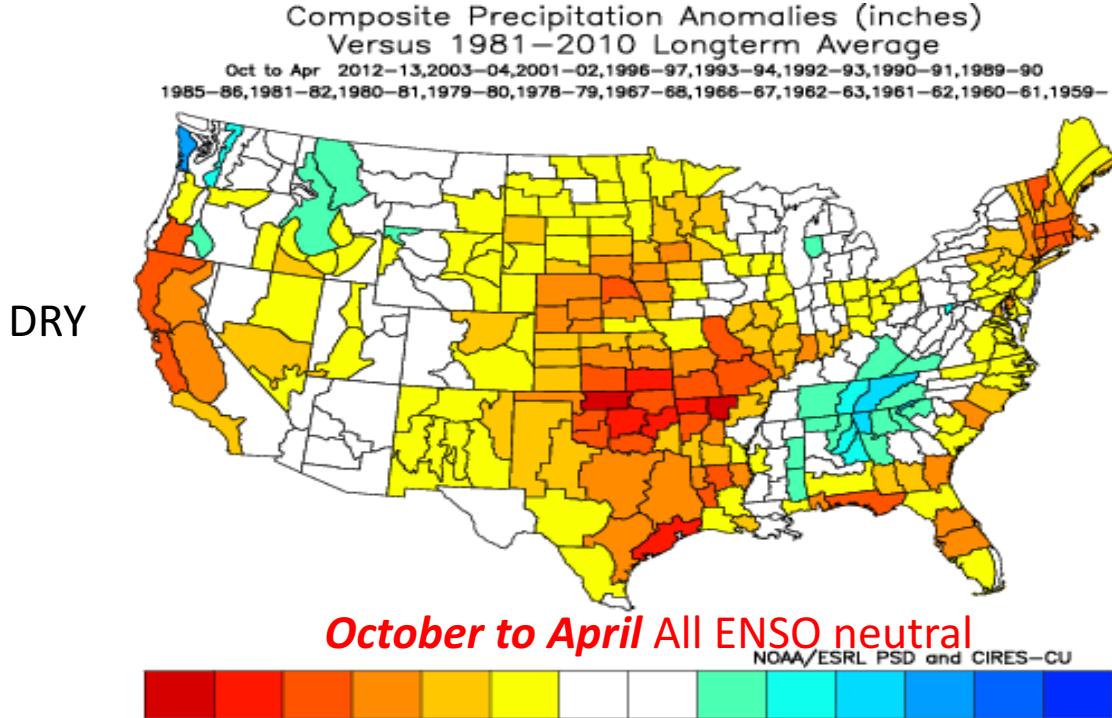
February

NOAA/ESRL PSD and CIRES-CU
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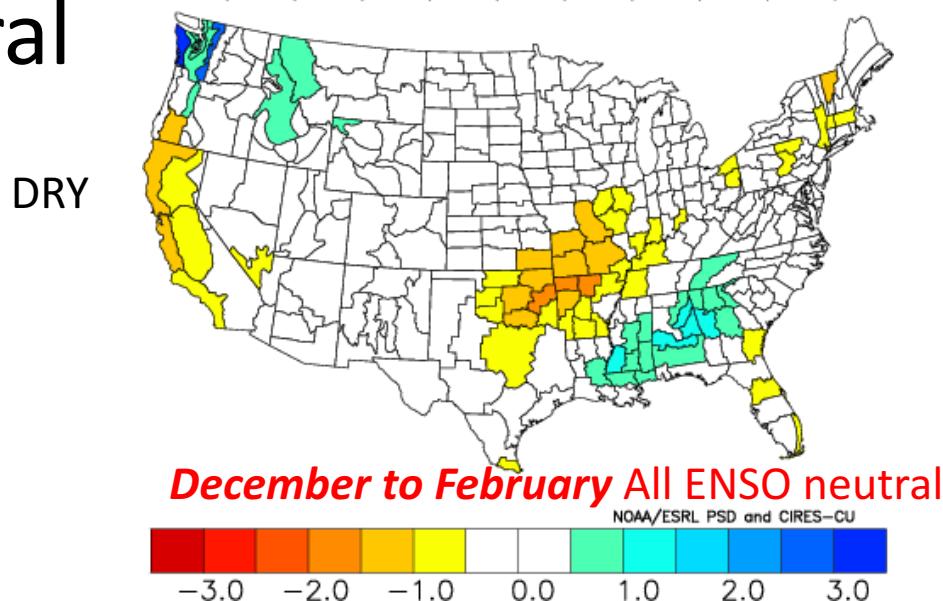


March

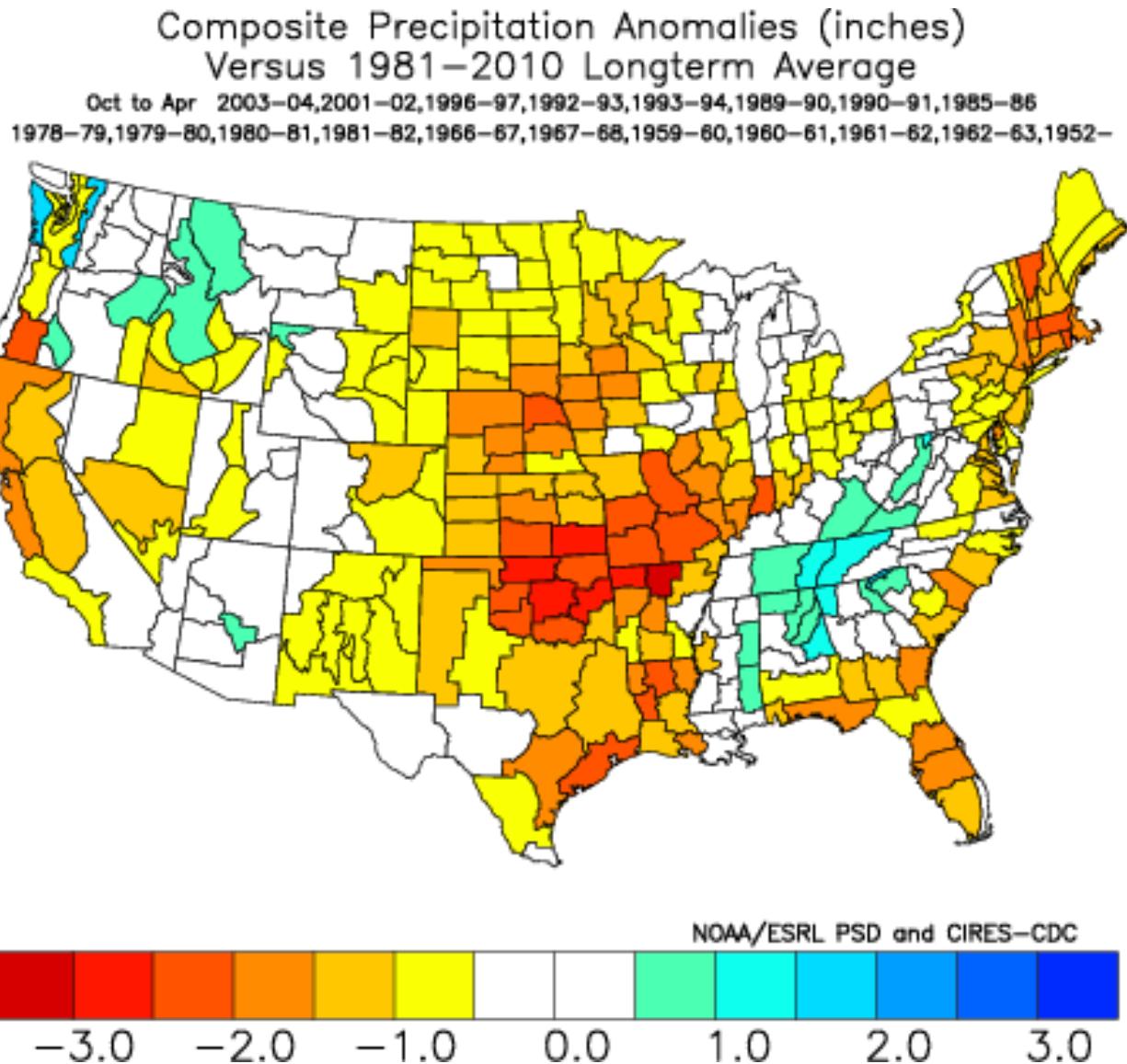
NOAA/ESRL PSD and CIRES-CU
-2.00 -1.50 -1.00 -0.50 0.00 0.50 1.00 1.50 2.00



Precipitation ENSO neutral

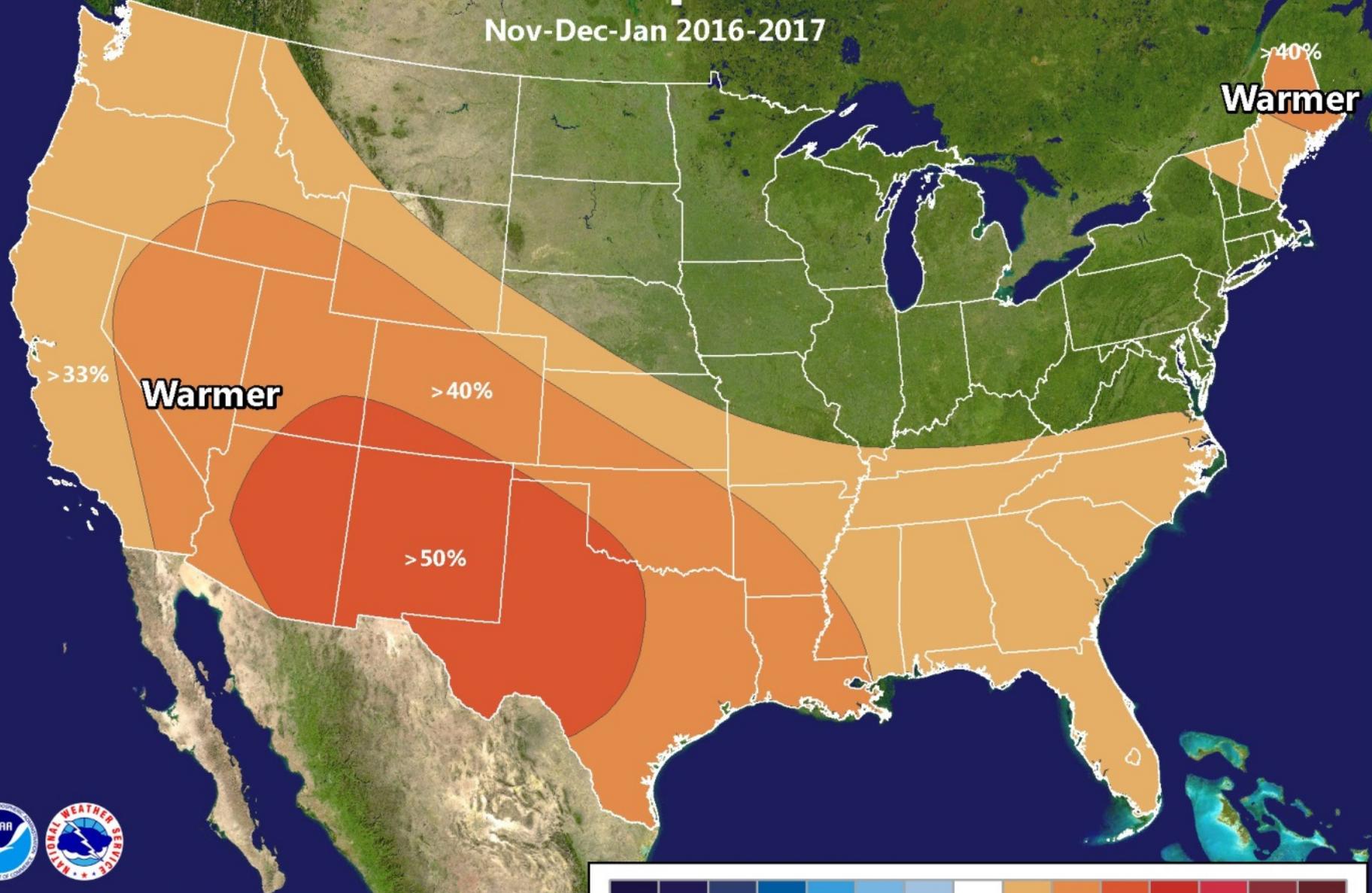


Neutral Years ENSO (-0.5 to 0.5 Ocean Nino index)



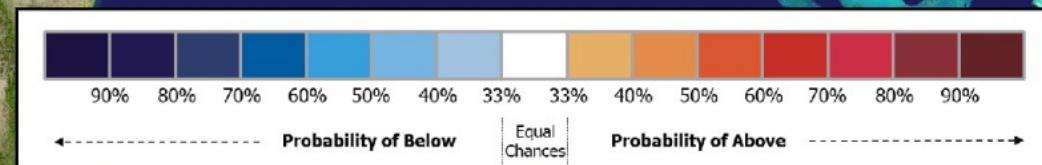
Three-Month Temperature Outlook

Nov-Dec-Jan 2016-2017



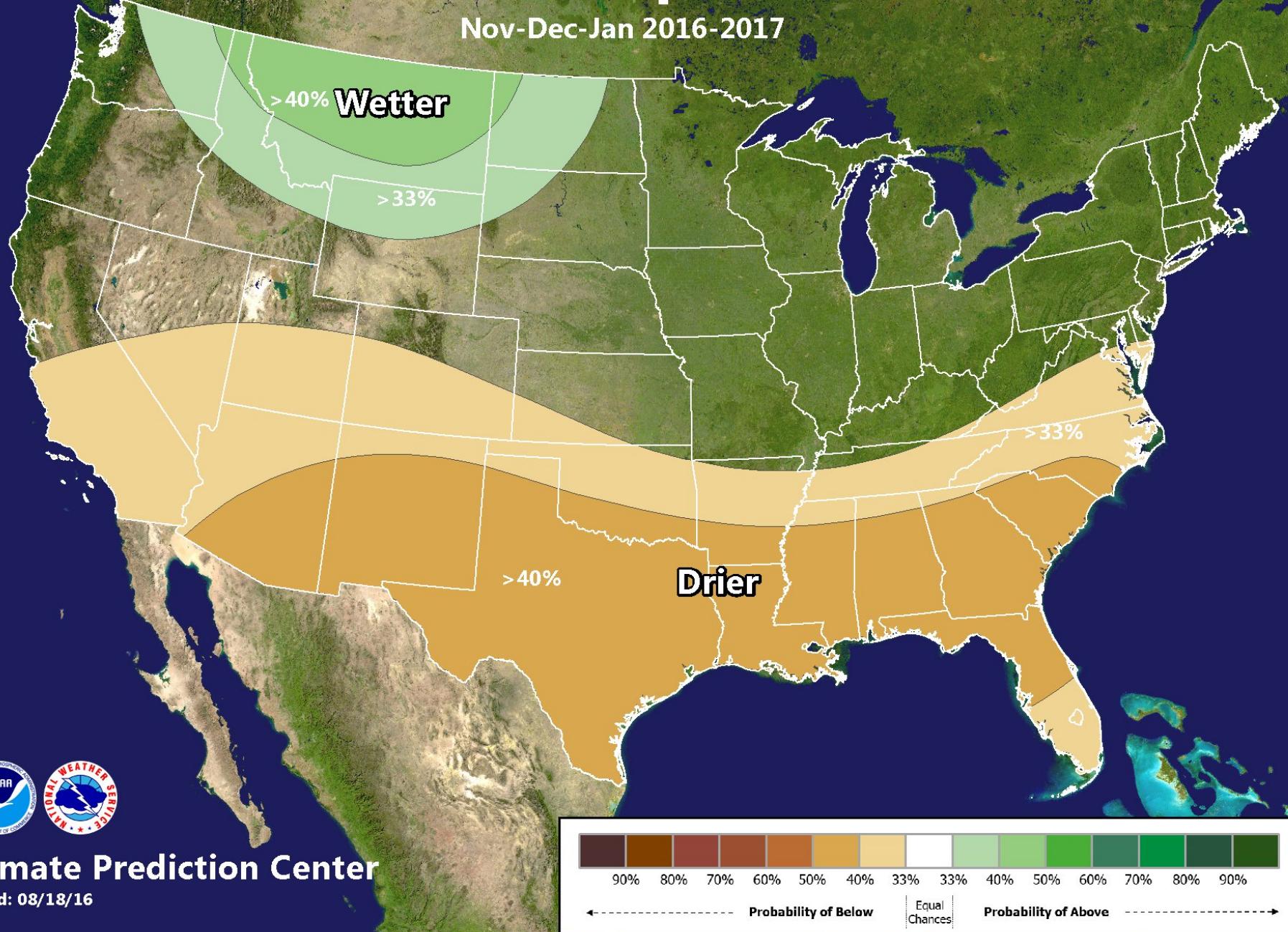
Climate Prediction Center

Issued: 08/18/16



Three-Month Precipitation Outlook

Nov-Dec-Jan 2016-2017



Climate Prediction Center

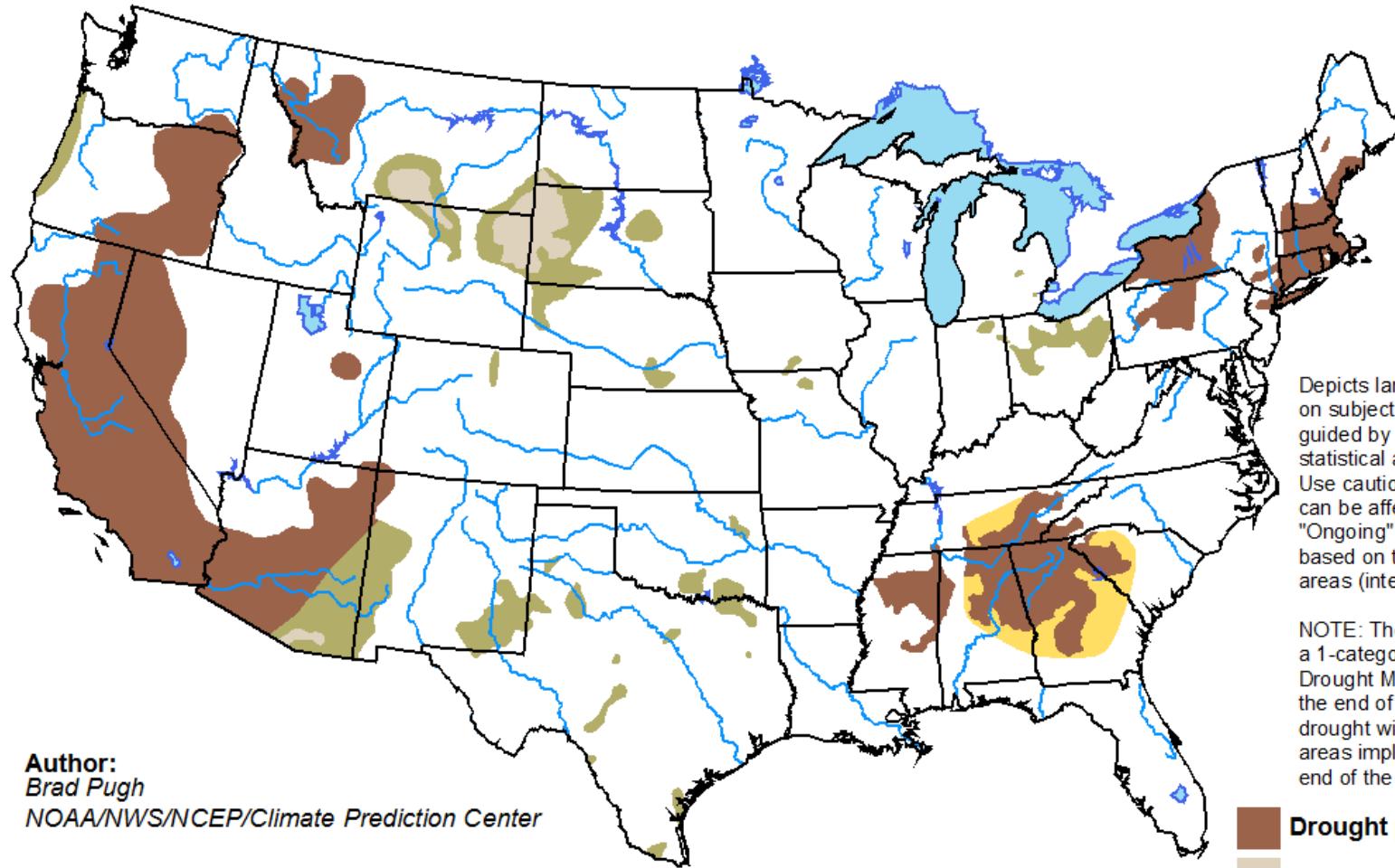
Issued: 08/18/16



U.S. Seasonal Drought Outlook

Drought Tendency During the Valid Period

Valid for August 18 - November 30, 2016
Released August 18, 2016



Author:
Brad Pugh
NOAA/NWS/NCEP/Climate Prediction Center

Depicts large-scale trends based on subjectively derived probabilities guided by short- and long-range statistical and dynamical forecasts. Use caution for applications that can be affected by short lived events. "Ongoing" drought areas are based on the U.S. Drought Monitor areas (intensities of D1 to D4).

NOTE: The tan areas imply at least a 1-category improvement in the Drought Monitor intensity levels by the end of the period, although drought will remain. The green areas imply drought removal by the end of the period (D0 or none).

- Drought persists
- Drought remains but improves
- Drought removal likely
- Drought development likely

